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No. 5

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This report contains information on national-level science policies, technology strategies, and research and development programs in West European science and technology in general and specifically in civil technology, with particular attention to transportation, energy, chemical manufacturing, industrial automation and technology transfer. The report will focus primarily on France and the Federal Republic of Germany, but will also cover important developments in Italy, the Netherlands, Sweden and other West European countries.

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SCIENCE AND TECHNOLOGY

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JOINING PIPELINES BY HYPERBARIC WELDING

Paris L'INDUSTRIE DU PETROLE in French Jan/Feb 79 pp 73-81

[Article by Guy Fleury, engineering director of Comex Services]

[Text] The starting up of production from the deepwater oil fields in the North Sea has led to the development of new techniques in the underwater works field. The spectacular advances made in underwater pipeline construction are a good example of this; and the connecting points of these pipes constitute a special area for submarine operations.

Since the North Sea context more than anywhere else encourages the search for the most reliable solutions, welding has been shown to be the optimum solution for these connections. Welding allows the pipe to be reconstituted as a monolithic whole and the joining point ceases to be a special point but becomes like any other point in the line with no special features.

The method applied uses pipe-handling methods and a process of dry welding in a high-pressure atmosphere. We find a few isolated examples of the application of this method at relatively low depths as early as 1968, but it was really in 1975, with the construction of the Frigg pipelines that high-pressure welding really came of age.

In this article, Mr Guy Fleury, technical manager of Comex Services, outlines the standard procedure for connecting underwater pipelines and high-pressure welding methods and then presents a typical project example. This project involves making the connections linking the Statfjord I platform to the swiveling sea-loading tower.

Operating Principle of the Joining Process

The pipes to be joined having been placed approximately parallel and a few meters apart from one another and after having marked the position of the joint the coverings of concrete and bitumen are removed with the object of cutting off the excess length. All of these operations are carried out by divers working in a saturation atmosphere and out of a diving turret. Initial alignment of the pipes is made possible by the use of hydraulic ports [portiques] (Figures 1 and 5).

Since the pipes are filled with water the cutting off of the excess length is accomplished by an oxyacetylene arc. Seals consisting of inflatable balloons are then introduced into the pipes and the latter, rough cut, are placed face to face with the object of positioning the welding habitats.

An ensemble consisting of habitat and aligner is lowered onto the planned point of junction. The aligner grapples grasp the pipes and jointed portals installed on the habitat provide for the watertight sealing of the latter (Figure 2). The habitat is nothing but a sort of parallelopiped-shaped box turned upside down into which a mixture of respirable helium and oxygen is injected, forcing out the water. The personnel is transferred into this habitat and works there dry but under hyperbaric conditions since the atmosphere is at the ambient pressure of the sea (Figure 3). The pipe-fitting crew proceeds to exactly align the two pipes by using the hydraulic commands of the aligner. Two parallel cuts are then produced which thus permit positioning of a junction sleeve; this sleeve is kept in place by clamps. The first welding crew is to do the welding at one extremity of the tube with the second crew completing the connection by welding the other extremity. During the entire operation the atmosphere of the welding chamber is automatically regenerated and maintained at a comfortable temperature (Figure 4).

The composition of the atmosphere, the humidity and the temperature are kept constant from the surface.

The welds are then X-rayed and the films developed at the surface. This permits immediate acceptance of the joint by an inspection agency or by the client himself....

The time required for such an operation is very variable as it depends upon local conditions and upon the means employed. A reasonable order of magnitude is 1 or 2 weeks of work.

Welding Under Hyperbaric Conditions

Considerable effort has been devoted to the development of welding procedures capable of providing, under hyperbaric conditions, welds which are of very high quality or are at least of a quality identical with that demanded of welds produced at the surface.

The three welding procedures, TIG, MIG and shielded arc electrode have been the subject of detailed studies and tests in our hyperbaric center at Marseille (Figure 6). To provide a procedure which would be applicable rapidly and on an industrial scale our choice at the outset was the procedure using the shielded arc electrode.

This procedure exhibits a certain number of peculiarities under hyperbaric conditions resulting primarily from contraction of the arc from rapid chilling in the helium atmosphere and from detectable variations in the composition of the metal deposited, as compared with results obtained at the surface.

Our efforts were directed particularly toward three points:

a. the welding equipment,

b. the welding material,

c. the welding procedure.

The welding source ought to have excellent dynamic characteristics in order to assure sufficient stability of the arc. Different forms of equipment have been studied and our choice settled upon a static source equipped with a telecommand system; the other advantage of this type of equipment is the ease with which it can be converted to undersea use.

The selection criteria of the welding materials was their ease of manipulation and their depositing characteristics. Our choice was a basic electrode having a low hydrogen content. Because of the significant increase, with increasing pressure, in the carbon content of the deposited metal it was necessary to prepare special electrodes in order to obtain satisfactory results at a depth ranging from 150 to 300 meters (Figure 7).

Finally the welding procedures were given special attention; because of the rapid chilling taking place in a helium atmosphere in order to obtain both acceptable values of resilience in the deposited metal and of hardness in the zone affected by the heat, the welding intensity must be selected and controlled with more than customary attention [being given to] preheating conditions and eventually to postheating. Once the procedure has been defined its use requires welders who are very competent and perfectly trained. In general five training sessions under hyperbaric conditions are required before a welder can be considered qualified in accordance with certifying organizations (Lloyds Register of Shipping or Det Norske Veritas, for example).

The personnel employed consists both of professional welders suited to life under hyperbaric conditions and trained toward this end and of divers trained in advance in welding at the surface before being trained in hyperbaric welding. Even after the first actual applications of this procedure

took place in the North Sea development studies continued to be carried out on these welding procedures. At the present time we are able to weld all the steels used in current construction and in pipelines down to depths of 300 meters.

Thus, by way of example, we have simultaneously given approval, at the end of 1977, to two welding procedures, one of these being shielded arc electrode, the other being MIG procedure using a pipe 20" in diameter--thickness 20.63 mm in API 5 LX 65 with 0.45 equivalent carbon, this being at a depth of 300 meters.

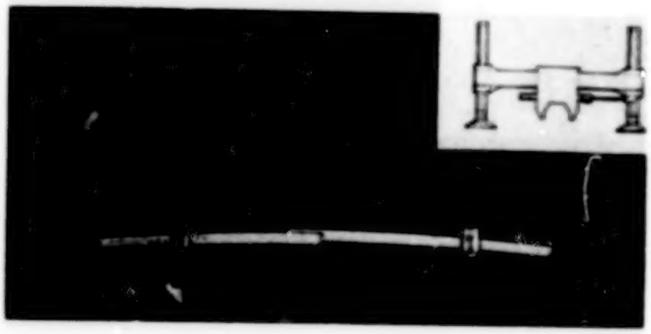

Figure 1. Rough alignment of the pipes.

Figure 2. Ensemble of equipment at the bottom during the operation.

Figure 3. Pipefitters working in the habitat. Positioning of the junction sleeve.

Figure 4. Regeneration of the atmosphere in the habitat.

Figure 5. Equipment assembly.

Figure 6. View from the Comex center for hyperbaric experimentation at Marseille.

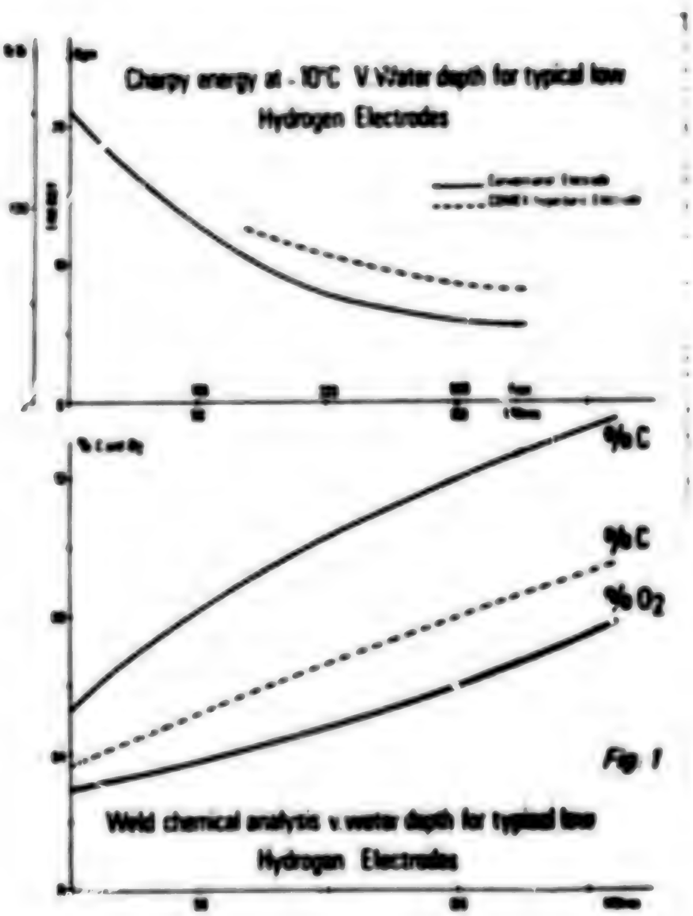

Figure 7. Evolution of the carbon content of the metal deposited, as a function of depth, by type of electrode.

A Typical Example of Joints Produced by Hyperbaric Welding

In 1977 Comex was assigned the task of producing joints on the 36"-diameter line connecting the Statjford A platform with the articulated loading tower in the sea. The platform and its riser, the pipeline and the loading tower bases being in place the work consisted in the installation at two ends of the pipeline of a "Z" sleeve to establish the junction and making it possible by its shape to absorb different relative movements (Figure 8).

On the loading tower side the sleeve weighed 45 tons and had to be welded to the two ends; on the platform side it weighed 44 tons and in its greatest dimension measured about 50 meters. It was joined by a strap to the riser and welded at the other end to the pipeline. This sleeve was installed during the summer using the Talisman barge (Figure 9).

This dynamically positioned barge is especially equipped for submarine construction work. It possesses a diving system making it possible to maintain at all times 12 divers operating in saturation. Dynamic anchoring is a feature which is particularly valuable in an operation of this type. By direct shifting of the position of the barge it makes it possible to position the sleeve on the bottom with speed and precision. At the same time this anchoring system makes it possible for the barge to be placed very close to the columns of the platform, to shift its position away from them and to return to the original position if necessary, with all of this involving only very short delays.

One can properly appreciate the significance of this advantage when one knows the obstruction to access to the platform existing during construction in consequence both of the service shipping and of the large construction barges.

Completion of the three other welded connections should in consequence yield a world record: three junctions by hyperbaric welding on a large-diameter line situated north of the 61st parallel in the North Sea in midwinter and operating from a semisubmersible dynamically anchored barge (Figure 10).

The Uncle John, the support used for these operations, is a semisubmersible dynamically anchored barge specially designed and equipped for submarine operations. It possesses a system of heavy saturation diving of which an important feature is undoubtedly the system of special anchoring of the tower which permits operations up to force 9 sea conditions. A hyperbaric welded joint ensemble composed of an aligner and of a so-called "Sea Horse 1" welding chamber and of two hydraulic lifts is permanently installed on this barge; the ensemble has worked continuously in the North Sea since June 1977 (Figure 11).

The work commenced on 10 December 1977 was terminated on 27 March 1978.

The first junction, on the platform side, was performed under conditions rendered particularly difficult by the meteorological situation at that time of year; to this one must add the extreme proximity of the Condeep Statfjord A platform making it impossible much of the time to adopt a heading which would most favorably confront the elements. In December there were recorded winds attaining 90 knots and waves of 46'. The dynamic positioning made it possible to take advantage of every meteorological window even when of short duration which was suitable for carrying out operations. Despite exceptional support performance more than 50 percent of the total time consumed in junction operations was spent in waiting for changes in the weather. The two other junctions carried out in January and March enjoyed surface conditions which were a little more clement except that technical problems which were basically more complex emerged: on the loading column side, the connection having been accomlished at 8 meters above the bottom; on the side of the pipe, the latter was buried at the bottom of a 3-meter-deep trench and from this there arose some alignment difficulties. Finally, 1,150 diving hours were required during a period of 2,500 hours elapsed on the site in order to accomplish these three hyperbaric welded junctions.

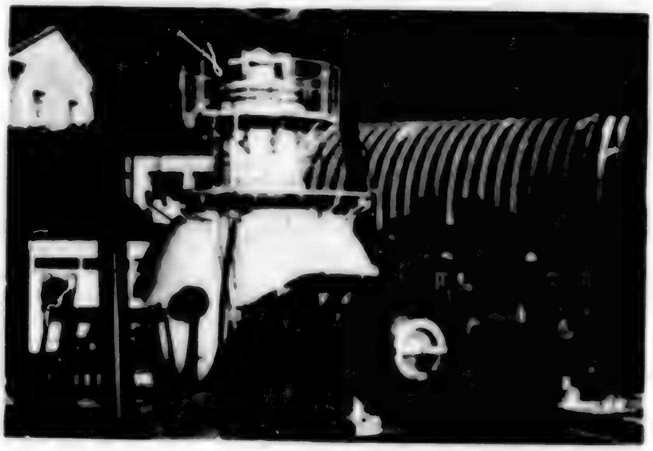

Figure 8. A "Z" junction sleeve.

Conclusion

While Comex accomplished four weldings in the course of the 1976 season in 1978 20 junctions will have been accomplished using 5 different ensembles, essentially in the North Sea but also in the Mediterranean and even in the Straits of Magellan. While in 1975 Total was the only operator in the North Sea using a technique of junction by hyperbaric welding, in 1978 six petroleum companies used this technique in the same region. This implies that in less than 3 years hyperbaric welding has succeeded in establishing itself as a quite conventional technique of undersea construction. The technique itself is public knowledge; if the perfecting and acquisition of the procedures

remains a delicate and costly operation, as is, moreover, the training of personnel, it is nonetheless true that the evolution of the equipment employed, into simpler and more reliable forms, and the extension of the domain of possible applications are developments which lead to significant reductions in cost and which therefore now make the procedure very competitive with other approaches which do not provide the same reliability.

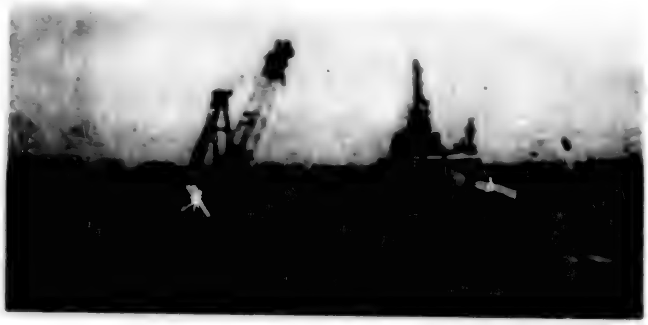

Figure 9. The Talisman barge.

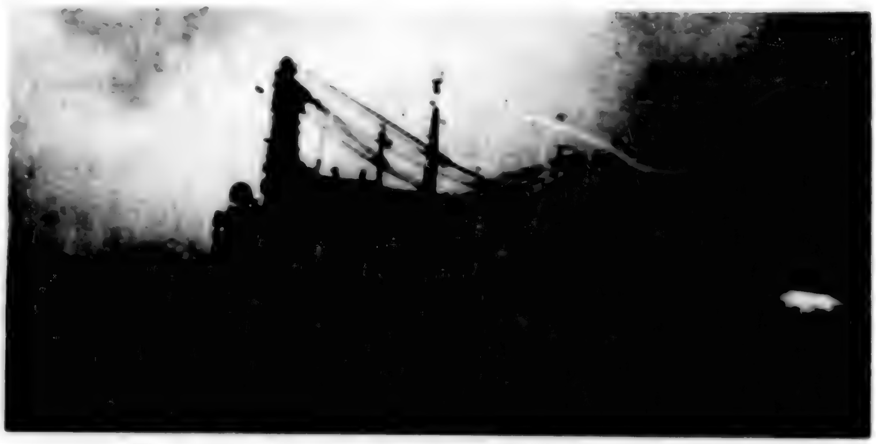

Figure 10. Uncle John on the Statfjord field.

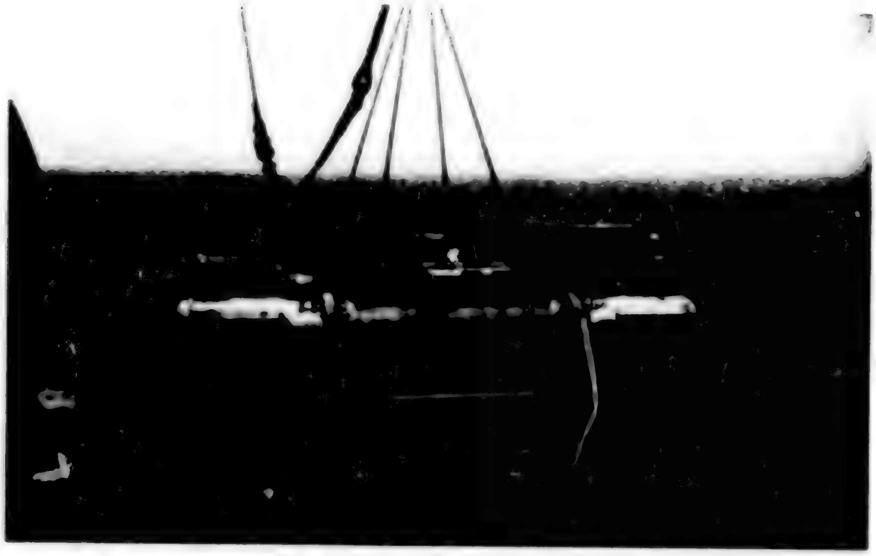

Figure 11. Putting the Sea Horse into the water from Uncle John.

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PLANS FOR TAPPING MARGINAL NORTH SEA GAS FIELDS

Paris L'INDUSTRIE DU PETROLE in French Jan/Feb 79 p 126

[Text] The European Community Commission has just granted a financial subsidy of 40 percent (2.2 MDM) to a 5.5 MDM project aimed at making possible the offshore exploitation of marginal North Sea natural gas fields considered up to now to be unprofitable. The responsible parties in this project are FMC Europe (Sens, France) and Salzgitter, Incorporated, and its affiliate PMS (Peine, Allemagne Federale), specialists in the manufacture of offshore cranes. The object of the French-German project is the development of a system of loading which shall be entirely metallic, reliable and compatible with criteria of environmental protection which shall permit direct transfer of the liquefied natural gas (GNL), of the liquefied petroleum gas (GPL) and other refrigerated liquids from an offshore terminal to high-seas methanizers under the very difficult conditions prevailing in the North Sea. This loading system which will avoid the costly positioning of "gazoducs" will be independent and ought to adapt itself to the different conditions encountered, with the consequence that the system will permit both the economical exploitation of small marginal gas deposits as well as the great quantities of gas accompanying the extraction of petroleum ("associated gas") and which at the present time are being burnt off.

The development project should be completed by the end of 1980 and the first loading systems could be placed in service around 1981/82 by the international petroleum companies. Of the gas reserves located in the North Sea below 62° latitude 60 percent can be economically exploited only by such a system and FMC assures its commercialization.

Drawing showing the FMC/Salzgitter system of offshore loading in operation.

8008
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PROCEEDINGS OF SEMINAR ON RESEARCH IN FRG REPORTED

Paris LE PROGRES TECHNIQUE in French No 14, 1979 pp 10-16

[Report: "Research in the Federal Republic of Germany"]

[Text] On 6 March 1979 the ANRT [National Association for Technical Research] sponsored a day of studies on the topic of "Research in Federal Germany," chaired by Pierre Aigrain, secretary of state for research.

This event, carried out with the cooperation of the Scientific Service of the General Office for Cultural, Scientific, and Technical Relations of the Ministry of Foreign Affairs, the councilor for scientific affairs of the French Embassy in Bonn, and the General Scientific and Technical Research Department, allowed a very instructive exchange of views with high German representatives of scientific, administrative and industrial circles.

The study brought together 170 people.

Following is a summary of the speeches and debates.

Speech by Pierre Aigrain, secretary of state for research.

I am particularly pleased to inaugurate a day dedicated to research in the FRG and to welcome here the presence of eminent German personalities who agreed to participate in this meeting. I thank them for coming to help us to understand the way in which the Federal Republic, a neighbor, friend, and partner, is conducting its research and development activities and, consequently, better to understand and resolve problems we ourselves must face.

A number of such days have already been held in the past on the subject you are discussing today. The first, held in the 1960's, indicated the faith in and enthusiasm for the possibilities opened by research and technology. At that time such activities benefited from rapidly expanding funds. Times

have changed. Under the presen. circumstances it has become more difficult to increase and, even to maintain the level of financing of R and D and, in more general terms, technological innovations. Yet, it is obvious today that science and technology are an essential key to problems of energy and raw material supplies, protection of the vital resources of our natural environment, and modification of employment and production structures in connection with the problems of developing countries and of demographic expansion

Today's meeting, held at a time when our two countries must reconsider their research and development policy in order to resolve all these problems, is particularly timely.

Our two countries gauge themselves on the same scale. They belong to the same cultural and economic entity, Europe, within which they maintain the closest possible relations and most important exchanges. The means at their disposal, means affecting research and development activities, are of the same order. They are experiencing similar difficulties: They are highly developed countries poor in energy and raw materials. Their economic structures face similar problems of adaptation to the fast changes throughout the world.

Therefore, useful information could be obtained as a result of a joint consideration of the means and objectives of policies pursued on both sides of the Rhine in terms of scientific research and technological innovations.

The striking feature in German research, to begin with, its extensiveness: 27 billion marks, and its continuity, for the share it represents of the federal gross national product has been 2.2 percent through the 70's.

Converting to another scale of measurement and to the list of FRG scientists who have been awarded the Nobel prize, I can number 13 since World War II. How not to deduce the face that the efforts made in the field of basic research have not been fertile?

Another remarkable point is the important share assumed by industry in the overall efforts, for it finances 80 percent of the cost of activities developed by the enterprises, totaling close to 17 billion marks.

Let me cite yet another odd figure for a time in which budget austerity is widespread: The increase, compared with 1978, of allocations placed this year at the disposal of the Federal Ministry for Research and Technology which, accounting for 18 percent on the basis of the budget decisions made by parliament, total 5.7 billion marks.

However, limiting ourselves to a comparison between figures would mean to restrict the study and the discussions to a rather superficial level. The organization and allocation of responsibilities on the level of the definition and formulation of a research and development policy, and on the level

of its implementation, could by themselves be the topic of a colloquium. Scientific research and technical innovation are very specific areas of activity which require the type of structures and management systems for which, I am sure, no country has as yet found a model.

Looking at the cities from which the French and German participants in this meeting come, we could say that this is not a Franco-German but a German-Parisian encounter. This is yet another illustration of the difference existing between our two countries, yours, which is federal, and ours which passes for centralized.

Yet, looking at the research and development structures, it is the FRG which has a centralized structure through the Federal Ministry for Research and Technology, i.e., the Bundesminsterium fur Forschung und Technologie (BMFT).

The BMFT is well known in France. The press reports coming from the other side of the Rhine mention nearly every day the activities of that ministry, the programs and installations it inaugurates, as well as its concerns. These are proofs presented to public opinion of the reality of the research and development policy, the importance which it assumes in terms of the future, and the interest in it on the part of the authorities.

To us, the French, who have a different structure, it is of particular interest to analyze with you the functions and responsibilities which your ministry assumes, the way it carries them out specifically, and the way its activities are coordinated with those of other ministerial departments involved in the federal policy for R and D. We are also interested in finding out the way this federal structure is coordinated with that of the Lander, some of which, unquestionably, have their own ministries of science or research.

Information, communication, and evaluation are the stages of the decision-making process which meet very specific conditions in the case of science and technology. Scientific information quickly breaks down with distance. It experiences a loss at each intermediary stage. It frequently is partial at the start and distored at the terminal. The levels of evaluation must be such as to make the necessary corrections and reconnect the missing links between results, in order to be able to formulate specific decisions. Similar difficulties exist in the implementation of decisions and adopted programs....

The result is that the level of management of the research and development policy must be close to the level of its implementation. They must participate in the development of science and technology.

Unquestionably, the role of research administrators has not as yet benefited from adequate attention. Yet, such administrators may be found along all the links of the decision-making chain. They gather and direct a number of ideas. It is through them that very substantial funds are channeled. They are able to note the results of programs and operations. They are also the

connecting elements between research and industry, and between pure and applied science. Unquestionably, in both countries they exist by the hundreds. How have they been chosen by the various institutions in charge of R and D in the FRG, and how do they operate? These questions should be raised and, unquestionably, we could trade experience on this subject.

One of the important points to be discussed is that of scientific employment which, in itself, is a difficult yet essential problem in terms of the mobility of researchers and their responsibility in taking part in programs or priority tasks pursued in the national interest. In fact, this problem is frequently raised in the following terms: Basic research laboratories need young researchers to contribute new ideas and capabilities; short of increasing the personnel, departures must make possible new hiring and ensure the transfer of research results and experience to the economy and society.

We are forced to note that, with few exceptions, and despite the efforts made to encourage such mobility, this is not the case, at least in France.

This urges us to examine the experience which our two countries have gained so that we may better appreciate the problem and become better familiar with the motivations and attitudes which lead to its solution.

In the case of industrial research, we shall certainly not fail to emphasize the size of the effort made by FRG enterprises, considering that, in 1977, it totaled 17 billion marks, as I mentioned. The rate of progression of this effort is satisfactory: In two years it rose 17 percent, at a time (1975-1977) when economic difficulties might have, conversely, led to a diminution of efforts whose results are never immediate.

The program of this afternoon's meeting is, therefore, of particular interest, for it calls for the discussion of several specific items of industrial research.

Such topics are of a different nature. Here again, we must not be satisfied with figures but try to see the nature of the actions of enterprises and the state.

Both of them promote an initiative-minded policy which consists, essentially, of two types of financial help. "Direct" help is manifested in our two countries in different ways, in terms of the degree of progress made in the technical development of operations to which it applies, and the nature of the programs for which it is allocated. More recently the Federal Republic organized "indirect" aid for research and development, also described as "automatic," in the sense that they represent a bonus allocated on the basis of general activities rather than the assessment of a specific project. We are following this experiment in France with the greatest possible interest.

The weighing of the two methods and the choice to be made among the various formulas through which they could be applied are that many questions to be discussed.

Whereas the aspects of public research sectors are substantially different between France and the FRG, it will become unquestionably apparent, in the course of the discussions this morning, that in terms of the areas covered by the ministries, excluding the particular features based on the specific aspects of the Lander, the systems used for the evaluation, financing, and management of public bodies are not different between our two countries in terms of their fundamental principles.

I am not sure that this is the case of industrial researc [illegible] virtue of the very fact that the FRG has a great variety of institutions [illegible] operate in connection with research and industry. In France we do not have such a variety of foundations and associations whose activities, in a very flexible way, are similar either in terms of the help they provide or the variety of innumerable annual discussions and meetings among scientists, technicians, researchers, and innovators of all kinds and in all areas.

Our industrial structures are also substantially different. The very idea of collective industrial research does not meet with the same response in our country as yours. Within the enterprises the role assigned to departments in charge of research and development, and the traditional role assumed by their managers in the development and the pursuit of such topics unquestionably show great differences.

It would be interesting to study such qualitative differences of structures and attitudes which, as we know, play an essential role, in order to be able to single out the specifics of the sectors engaged in industrial research in our two countries. That is why a discussion on the various organizations of the mechanisms of innovation and ways of intervention of all kinds which could assist them would be extremely profitable.

In conclusion, I believe that this day would enable us to make comparisons and, above all, to get to know each other, the result of which would be action.

The cooperation between German and French scientific and technical institutions, several decades old, has been developed steadily. This is confirmed by a number of examples and I would blame myself for not naming here some of them: The high-flux reactor, Laue-Langevin Institute, intense fields, the satellites within the Symphony program, etc.

Yet, it would be premature, in my view, to conclude that this has made the scientific and technical publics of our two countries know each other better. I would rather say that, by the very nature of the development of their cooperation, a growing need is developing for their better reciprocal acquaintanceship.

I have mentioned the different features of our organizations, methods, and attitudes. Such differences could easily turn into obstacles to understanding the moment they lead to the establishment of contacts between non-corresponding decision-making levels or develop administrative or technical approaches which use different ways of thinking....

Closer cooperation implies reciprocal knowledge of each other enabling us to properly understand such differences, take them into consideration, and thus reciprocally enrich ourselves.

There is no better area than science for gaining the greatest benefits from such a complement. Above all, this applies to knowledge of our respective programs. Such knowledge must not be limited to the content of the programs but must also be familiar with their logic, presentation, and motivations. It is such a knowledge that would enable us to bring closer to each other the prospective evaluations which lead us to the formulation of such programs. Some of them could be drafted jointly and even structured in such a case as to complement each other and provide better cooperation conditions.

Today's meeting seems to me to be the best way for preparing a deepening of such profitable cooperation.

That is why, personally, I await its conclusions with interest.

Speech by Maier-Leibnitz, president of Deutsche Forchungsgemeinschaft (DFG).

Allow me, to begin with, to cite a few figures.

The sum total of appropriations for research and higher education for 1978 totaled 40 billion marks, 11 billion of which for higher education. Over the past 10 years this amount doubled and even though salaries and costs have greatly risen over the same period, we note, nevertheless, a significant increase.

The 29 billion marks appropriated for research are divided in roughly similar amounts between the authorities (the governments of the Bund and the Lander) and industry.

The programs of the federal government have been greatly increased in recent years. Their breakdown is the following:

- 4.4 billion marks for the program of the BMFT (Forderungsprogramme);
- 3 billion marks for the programs of the ministries (Ressortforschung);
- The joint efforts of the Bund and the Lander in charge of the universities.

The Bund aid for research and development by industry totals 3.7 billion marks. On the other hand, the Bund has allocated 4.1 billion marks for non-university research institutes and 0.6 billion marks for university research.

You see, therefore, that appropriations for aid to non-university research are relatively substantial.

It will be interesting now to examine the targets issued by the government and the Ministry for Research (BMFT) for their research programs: "Research planning is determined exclusively by the desired results. Technologies, assessed on the basis of their objectives, will be submitted to individual evaluations...."

What seems to me to be of interest in this statement is the fact that research and technology here are mixed and that the established priorities of such a policy apply to both.

The total budget of the universities is 17 billion marks per year. It is estimated that 5 billion goes to research. This figure seems to be justified by the fact that the personnel involved consists of 30,000 professors, 26,000 associates, and 21,000 officials or employees, which is about 63,000 science workers engaged in research. In fact, it could be stated that 80 percent of university science workers are engaged in research, one way or another.

In Germany, as in most industrialized countries, important research centers were created after the war. The first were in the area of nuclear research. Now, however, we have 12 centers covering a variety of sectors. Their budget totals 1.3 billion marks per year for 4,000 science workers.

The work programs of these centers have been defined by the government. Since their targets cover research as well as development, their requirements in terms of manpower and materials are quite substantial. Let me cite as an example the Center for the Study and Development of Accelerators and Reactors, whose programs cover plasma physics, fusion, uranium recycling, radiation protection, and reactor safety.... These centers have the necessary capital equipment to support basic research.

Finally, there are specific major technological projects such as nuclear fusion and satellites....

Coordination groups have been established to direct these projects. For example, a coordination group of 40 members was set up to manage the project of improving labor conditions, at the cost of 50 million marks.

The budget of the Max Planck Gesellschaft, which I shall discuss briefly, is 700 million marks. It involves 1,700 scientific workers engaged in "free" research. The researchers selected for this field are with proven ability in the field, for which reason they are free to choose their research topics within the area.

The DFG as well has a 700 million mark budget to pursue 14,000 projects, 7,000 of which are new every year, with a project budget of about 100,000

marks per year. These projects are submitted by individuals most of them working at universities, as a result of which the DFG subsidizes about one-third of all university research. The 100,000 marks appropriated for projects are to be used not as payment to the scientific workers who suggested the topic but to cover the costs of the materials (32 percent) and the additional personnel required (68 percent). The university pays not only the salaries of the scientific workers, but also absorbs the cost of the buildings, capital equipment, and documentation, which means that each project does not cost 100,000 marks but 200,000-300,000 marks.

In addition to such studies suggested by individuals or groups, we have what you call in France topic programmed actions for which we call for bids to work on topics deemed important.

Scientific workers are influenced in their choice of research topics by public opinion, the media, and politics, for which reason the DFG must subsidize not only basic research but, above all, applied research. It is thus that the first scientist who drew attention to the danger of the coloring used for butter was awarded the Nobel Prize. As the result of his intervention a work group, still in operation, was set up.

The DFG was also the first to be concerned with production from nuclear radiation and water treatment.

We want to make the scientific workers responsible for the consequences of their discoveries and to participate in public and political life.

In terms of fixed marks there has been no increase in the research budget over the past five years. This stagnation is related to the personnel situation in the universities. Only 2 percent of the positions are vacated annually. At the present time there are six times more students who would like to remain with the universities than there are job openings. This has led to a new situation according to which students who would like to write a thesis must know that they will be unable to make a career in the university and that they will be forced to work in industry after graduation. This leads to the risk that some students may terminate their studies before their thesis.

At the present time we do not know how the situation will develop in the future.

To sum it up, basic research may be divided into three major areas:

- Free research, conducted in the universities, the DFG, and the Max Planck Gesellschaft,.... currently in a state of stagnation;

- More practically oriented research, which we shall discuss this afternoon;

- Planned research whose topics have been defined on a more political basis.

Such research must not become technocratic. It must take into consideration the human aspects, and our Ministry of Research considers that in this area Germany is more successful than France.

The Discussions

Plattenteich (Director at the Federal Ministry of Research and Technology--BMFT): Allow me to draw your attention to some problems which we encounter in Germany in the field of research. Scientific progress is competing with other objectives set by our society, and the BMFT budget must compete with the budgets of other ministries such as health or transportation.

We equally note a growing resistance on the part of the youth to technological progress which it considers responsible, among others, for the growth of unemployment based on the fact, for example, of the development of automation and the application of microprocessors.

On the other hand, we must pay great attention to the social implications of technical progress, making important efforts to improve, for example, working conditions.

Finally, the lack of mobility of researchers in the major research centers is a very important problem we face in Germany.

Aigrain: I believe it is obvious that no country in the world has been able to resolve such problems and contradictions. However, had the effect of technology on employment been negative, we should have noted that on a global level. Yet, this is not the case. World industrial employment has never before grown so rapidly. What is occurring is that this growth has been localized in the developing countries. I believe that this is an element benefiting the global equilibrium.

As to the idea of worldwide technological disarmament, which would be the only way to block the so-called adverse effects of technology, it appears to me to be far more utopian than that of a military disarmament.

I consider that in the condition of economic competitiveness in which our societies find themselves, our countries are condemned to follow a technological course forward which alone would enable them to maintain themselves on the level of the other industrialized nations.

Curien: Mr Maier-Leibnitz, some two years ago you were asked to chair the work of a group of scientific workers whose task was to determine priorities among major competing research projects. Were you able to set such priorities and did they help the German government in its decision-making process?

Maier-Leibnitz: In Germany the budget appropriated for investments in major projects and that allocated for international scientific cooperation are different from those of the "Max Planck" or the DFG, which gives us greater freedom of choice to the extent to which, should we decide to support a major project, we know that this will not be to the detriment of the research conducted by these institutes. The committee you mentioned did, in fact, submit suggestions and implementations are underway. It also proposed that one or two percent of budget allocations for major projects be set aside with a view to initiating entirely new research projects every year.

Chabbal: In France we are under the impression that in the field of the transition of academic researchers toward industry, Germany is currently in the situation of France of 10 years ago, i.e., at the end of a very strong growth of university cadres. Were you able to establish a link between the academic and industrial sectors? Do you have the feeling that the reaction of the industrialists toward researchers is different in our two countries?

Maier-Leibnitz: I believe that mobility in the direction of industry is more important in our country but that we are in a transitional period in which a new balance will have to be attained.

Plattenteich: I shall discuss only the situation of the major research centers which employ 16,000 people, 4,200 of them scientific personnel. In the 1960's, the growth of cadres was very rapid and we hired many young researchers. For the past few years there has been virtually no hiring of research workers. Conversely, operational allocations have been rising regularly. Wages in these centers are relatively good: Salaries comparable to those made in the public sector, considerable advantages, and stable employment, as a result of which we have very few people leaving, ranging from two to five percent per year, according to the center. Retirement vacancies average two percent per year, a figure which will continue to diminish until 1980. This is further aggravated by the fact that there are very few openings in industry or the universities. All these factors lead the researchers to consider their job as employment for life, which faces us with considerable problems.

Schopper (president of Major Research Centers Association--AGF): The major research centers were established some 15 to 20 years ago. At that time there was substantial hiring of young researchers, and it is not before roughly 1995 that there will be substantial retirement. In order to remedy this situation, we have contemplated either a lowering of the hiring age (under 30) or hiring researchers on a contract basis, for periods not exceeding five years. Both solutions, however, appear inoperative. We are rather considering the opening of 400 to 500 jobs for 10 to 15 years, to be abolished when the expected retirement takes place.

Chabbal: In the Anglo-Saxon system, the fact of having spent several years in research increases the value of a scientific worker in the eyes of

industrialists. This does not seem to be the case in France, for industry recruits most of its research personnel from the schools of engineering. Is the situation different in Germany?

Plattenteich: My personal opinion is that this depends, on the one hand, on the field of research and, on the other, on the time spent at the university. If it is a question of applied research or applicable basic research, I think that opportunities would be more numerous. As to the second factor, a three-year period spent in research seems to me favorable whereas 10 years spent in research would be a major handicap.

Loosch (director at the BMFT): The same mobility problems may be found in administration. As to the attitude of the industrialists, I would say that even if they are willing to employ researchers produced by the academic system, the current economic conditions are such that there are no openings.

Brousse: In France the attitude of industry concerning university researchers is not new. A long tradition exists according to which the natural reservoir from which the industrialists draw their scientific cadres is the schools of engineering. I would like to know if traditional German industries such as timber, textiles and, above all, machine, hire graduates from the academic sector?

Plattenteich: Let me add that the most frequent reproach voiced by small and medium-sized industrial enterprises in Germany concerning academic researchers is that they were not trained for the tasks which the enterprise would like to assign them.

Maier-Leibnitz: A fundamental difference exists between France and Germany in the sense that in our country there are no engineering schools. A university graduate could quite naturally be an engineer. Then, the situation greatly depends on the sector. For example, there are engineers in Aachen (Aix-la-Chapelle) who enjoy worldwide reputation in the field of mechanics, for they have been interested for quite some time in the new technologies in the sector. In am convinced that they would have no problem finding employment in industry.

I have never come across good researchers who were unable to find a job in the private sector.

Shopper: It seems to me that the area in which a researcher has worked is of little importance. What is essential, in my view, is to teach the students to apply a certain number of thinking methods and advanced technologies. Such being the case, I think that studies in Germany last too long and that this is a very severe handicap in terms of professional life.

Maier-Leibnitz: I think that we have discussed extensively the problem of mobility and that we could now discuss that of the balance between free and programmed research.

Morin: Research can never be entirely guided either by scientists frequently cut off of economic realities or officials who have no knowledge of scientific problems. We must be able to define a set of problems which would enable us to formulate individual economic and societal problems in terms which scientific workers could understand.

In France we have chosen to define a certain number of priority and basic objectives facing our society while leaving a certain freedom to the scientists in the choice of their research subjects within each topic.

Donnet: Could an idea be gained of the efficiency of the work of research groups working on topics selected by the scientific workers themselves (Sonderforschungsbereiche), disposing of a budget of two million marks per year?

France has its Programmed Topic Actions of the CNRS [National Center for Scientific Research] or Concerted Actions of DGRST [General Delegation for Scientific and Technical Research]. However, these two ways of intervening are not comparable to what exists in Germany in terms of available funds and freedom of choice of topics.

Chabbal: This focusing of means on specific topics is developing in France, particularly as scientific interest groups. However, their financial allocations are, unfortunately, not of the same size.

Maier-Leibnitz: The Sonderforschungsbereiche were set up some 10 years ago. They account for approximately one-third of the overall budget of the DFG. They are assessed by the members themselves (about 40). The results of some are excellent. Others are terminated before the stipulated deadline. What makes them interesting is essentially the fact that it is the researchers who choose their research topics.

Gavoret: Seventy percent of the funds for basic research, provided by the DFG, go to salaries. Does the thus remunerated personnel hold positions of scholarship or permanent positions?

Maier-Leibnitz: Actually, the young researchers are employed by the university while the professor retains scientific responsibility. They are employed on a contractual basis, for we do not wish to aggravate the mobility problem. Naturally, to the extent to which it is possible, we try to reclassify them at the end of their contracts on the basis of available jobs.

Curien: I believe that Mr Gavoret's question dealt rather with technicians employed in research, who are unwilling to accept such limited contracts to the extent to which, whatever the research program may be, they are asked to perform the same type of work whether with a machine tool or a computer.

Gavoret: How are research administrators selected at BMFT? What is their training?

Plattenteich: In the German ministries most of them are lawyers. However, the BMFT is an exception to the rule. We employ administrators who are former scientific researchers or who have worked in industry and have quickly acquired the necessary administrative skills. I must say that this is a situation which favors good research management.

Loosch: Thirty percent of the BMFT personnel are lawyers.

Danzin: This ultimate point seems to me to be quite important. We must absolutely develop a climate sympathetic to research problems among decision makers in industry or the administration. The mobility of the researchers must not exist only within research. It must make it possible for scientific workers to reach decision making positions in order to improve the dialogue between researchers and decision makers.

Speech by Mr Krupp, director of the Innovations and Systems Analysis Research Institute (ISI) of the Fraunhofer Company

I would like, if you will, to give you an overall view of applied research in the FRG. I shall discuss in particular the enterprise sector. However, the latter cannot be separated from the public bodies to which it is connected in a multiplicity of ways, as you will see.

Figure 1 shows the situation in 1978. The industrial sector is contributing to the German research and development effort a total of 14.4 billion marks. Only one percent goes to nonindustrial universities and laboratories. Conversely, 40 percent of nonuniversity public research funds go to laboratories within the industrial sector.

Table 2 enables us to make certain comparisons between France and Germany.

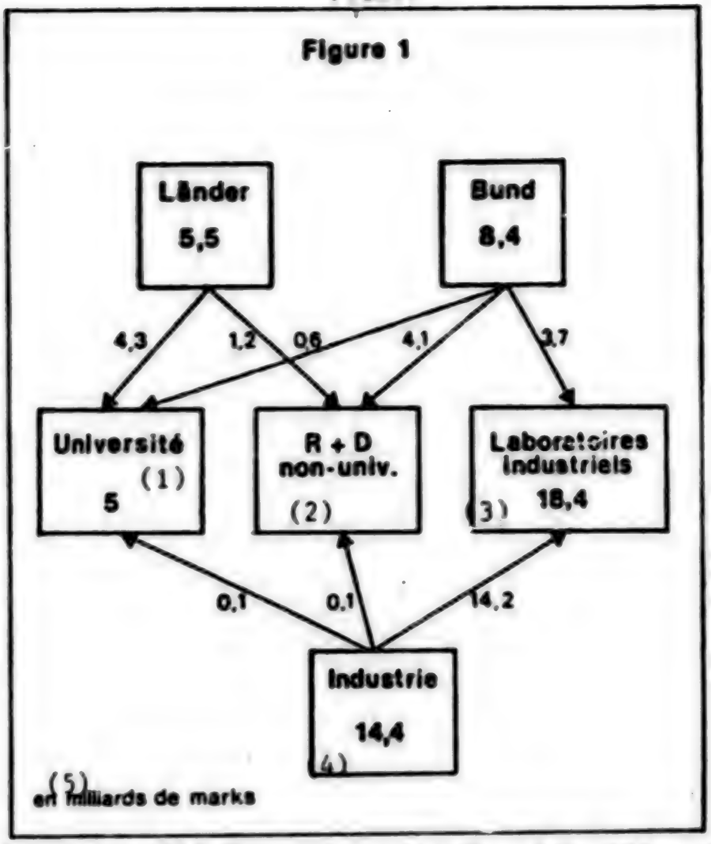
We note that the number of researchers and engineers employed in research and development in our two countries is quite comparable. The figures pertain to 1975 but I do not think that those of 1979 would be too different.

The most important difference is probably the fact that in France there are more researchers in the public sector than in Germany. The difference in terms of the state funding of research and development in industry has lessened somewhat today, the figure for Germany having been increased from 17.9 to 20 percent.

Table 3 which shows a sectorial comparison, was provided by a foundation subsidized by private German industry. The figures are for 1975, but are roughly applicable to 1979.

The most important differences are found in chemistry, aeronautics, and the complex sectors of mechanics, optics, and the nuclear industry.

Figure 1.



Kwy: (1) University; (2) Non-university R and D; (3) industrial laboratories; (4) Industry; (5) Billion marks

Table 2.

Tableau 2
(1) Personnel de recherche et développement (1975)

	Total	(3) % dans l'industrie
(2) RFA	286 000	65,1
France	214 000	56,6

(4) Exécution de la R et D dans l'industrie

	Total (en millions) (8)	(5) Source financière: (6) Industrie	(7) Secteur public
(2) RFA	14,5 DM	78,8 %	17,9 %
France	15,6 F	68,9 %	25,4 %

Key: (1) Research and Development personnel (1975); (2) FRG; (3) Percent in industry; (4) R & D in industry; (5) Financial source; (6) Industries; (7) Public sector; (8) Million

Table 3.

(1) Tableau 3 Dépenses de R et D par secteurs industriels (1975)		
Secteurs (2)	RFA (%) (3)	F (%)
Agriculture (4)	0	0,6
Extraction et première transformation (5)	2,1	0,9
Electricité, Electronique (6)	27,3	29,5
Chimie (7)	26,7	17,8
Aéronautique (8)	8,7	18,8
Véhicules (9)	10,6	10,2
Fonderie, Métallurgie (10)	2,8	3,8
Mécanique, Optique, Nucléaire (11)	12,7	4,8
Alimentation, Cuir, Textile (12)		
Caoutchouc, Plastique (13)	1,8	5,7
Autres secteurs (bois, papier, verre) (14)	0,9	2,1
Services (énergie, eau, travaux publics) (15)	3,3	5,6

Key: (1) R & D expenditures by industrial sector (1975); (2) Sector; (3) FRG; (4) Agriculture; (5) Extraction and prime processing; (6) Electricity, electronics; (7) Chemistry; (8) Aeronautics; (9) Automotive vehicles; (10) Foundries, metallurgy; (11) Mechanics, optics, nuclear; (12) Food, leather, textiles; (13) Rubber, plastics; (14) Other sectors (timber, paper, glass); (15) Services (energy, water, public works).

Table 4 shows contribution which the enterprises made to research and development in terms of the number of salaried employees (1975 figures). We note that the contribution of small and medium-sized enterprises[1] to research and development is very small--less than 10 percent--even though such enterprises employ 50 percent of the workers in industry. In terms of these statistics, the chemical industry whose research and development expenditures account for 26.2 percent of the total fail to provide detailed figures.

If we consider now the evolution of research and development financing in Germany over the next two years we shall note that an effort will be made in the following sectors:

- Natural resources: energy, raw materials, environment;
- Production modernization;
- Amelioration of labor conditions, an area in which a major program exceeding 200 million marks is being implemented. Actually, such a program is somewhat ambiguous: it is difficult to differentiate between the extent to which the installation of an automatic machine is aimed at humanizing labor or at increasing labor productivity.

1. By definition, in Germany an enterprise is considered to be small to medium-sized if its turnover is under 150 million marks and if it employs less than 1,000 salaried workers.

Table 4

Tableau 4 (1) Dépenses de R et D par type d'entreprise	
Nombre de salariés de l'entreprise (2)	(3) Part de la R et D effectuée (en %)
< 100 (5)	0,2
(4) de 100 à 499	1,4
de 500 à 1 999	5,8
de 2 000 à 4 999	7,8
de 5 000 à 9 999	6,1
> 10 000	52,8
Total	73,8
Chimie (6)	26,2

Key: (1) Research and Development expenditures by type of enterprise; (2) Number of enterprise salaried personnel; (3) Share of research and development (in percent); (4) From; (5) To; (6) Chemistry.

Table 5 shows the priorities of the Ministry of Research in terms of research and development. This information is quite important to the extent to which the BMFT allocates over two billion marks to industrial laboratories.

Table 5

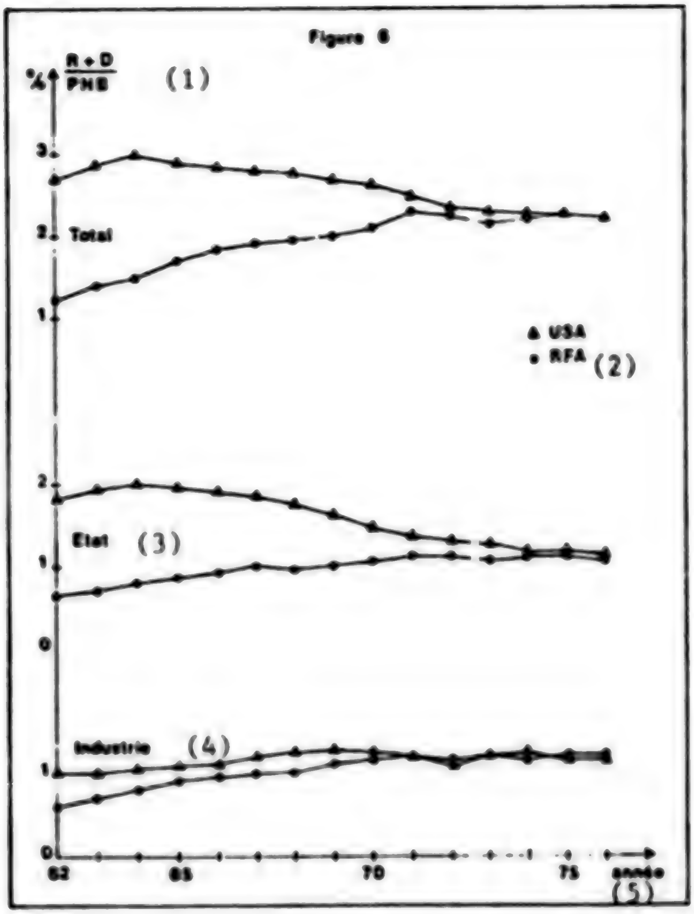
Tableau 5 (1) Priorités budgétaires du BMFT (1979)		
Domaines (2)	(3) Montant (en millions de DM)	Variation (4)
(5) Amélioration des conditions de travail	85	
(6) Santé	55	
(7) Biotechnologie, Ecologie, Environnement	195	+ 46 %
(8) Océanologie	106	+ 30 %
(9) Communication	30	+ 50 %
(10) Transports, Technologie des villes	309	+ 50 %
(11) Energie non-nucléaire	533	+ 25 %
Budget total 1978/79 (12)	5 500	+ 14 %

Key. (1) Budget priorities of the BMFT (1979); (2) Area; (3) Amount (million DM); (4) Range; (5) Amelioration of labor conditions; (6) Health; (7) Biotechnology, ecology, environment; (8) Oceanography; (9) Communications; (10) Transportation, urban technology; (11) Non-nuclear energy; (12) Total Budget.

It is obvious that we note an evolution of such priorities, even though slow. It is interesting to note that 54 percent of the BMFT funds go to specific projects rather than to the functioning of public research bodies.

Figure 6 shows the evolution of the ratio between research and development expenditures and the gross national product in the United States and in Germany.

Figure 6



Key: (1) Research and Development / Gross National Product

(2) FRG

(3) State

(4) Industry

(5) Year

This diagram, which is of some interest, shows a double convergence:

- The share of R and D expenditures in the gross national product in the FRG tends to become similar to that of the United States. This applies to both public funds and industry.

- All curves are asymptotic to horizontal: There is stabilization and saturation. The American figures show attempts at rationalization: The

United States has abandoned certain ideological, military, and spacial luxuries. The German figures, conversely, after a steady growth, seem to stabilize at their present level.

For some time technological and industrial policy has been focused in particular on support for and favoring small and medium enterprises.

The essential aspects of this policy are the following:

- The government tries to increase the share of small and medium enterprises of major national programs such as energy, health, electronics, etc.

- A system of indirect help has been organized as follows:

The state ascribes prime importance to investments related to research, development, patents, licenses, and know-how (maximum participation of 20 percent);

Contract based research is subsidized to the 30 percent level;

R and D personnel is partially supported by the state with a ceiling of 400,000 marks per year and per enterprise.

It is considered that the program will cost about 300 million marks per year. A contribution of the state would be the same as the R and D budgets of small and medium-sized enterprises.

Several hundred requests for aid were submitted the first year. A request is answered within one month.

Finally, I would like to discuss the regional breakdown effort. Within the framework of a trial program which will last from three to five years, the state will subsidize a wide network of technological transfer agencies. These agencies are under the following jurisdictions:

- Local chambers of commerce and industry;
- Regional centers for the development of productivity;
- Any given sectorial industry union such as those of machine building or steel sheets and profile iron;
- Universities (Bochum, Regensburg).

The purpose of such agencies is to establish contacts with small and medium-sized enterprises in the field of new technologies and products. I believe that you may be interested to know that the purpose of the organization of this network is also to engage in marketing public research programs in small and medium sized enterprises in order to stimulate them and put them in touch with public financing and technology sources.

This aspect of the national effort in support of innovation involves as much industry as the federal government and the Lander.

I shall conclude my presentation with a few thoughts on economic growth.

The rise of the German gross national product, which averaged 12 percent in 1950 has declined in recent years to an average of approximately 3 percent.

This change affects the various economic sectors in quite different ways.

According to the 1973 scenario, by 1985 the development of the employment situation will be the following:

- It would rise steadily in machine building, electricity-electronics, chemistry, plastics, and aeronautics;

- It would remain stable in the food industry, furniture, printing, and metal construction;

- It would be reduced in textiles, metallurgy, and mines.

Today in the first category sectors our predictions are less optimistic.

Germany is probably a favorable ground for the following industries:

- Those using very high-level technology, benefiting from brain power;

- Those looking for the lowest cost of raw materials, energy, and pollution.

Large scale manufacturing, operating on a high efficiency level and very flexible, operate in a favorable environment.

This is, at least, the theory of the macroeconomists. However, our reality is far more complex and the risks remain unpredictable.

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FEDERAL REPUBLIC OF GERMANY

COMPUTER-CONTROLLED MANUFACTURING

Basic Methods Outlined

Duesseldorf HANDELSBLATT in German 8 Oct 79 p 192

[Text] The situation of production enterprises in the highly developed industrial countries is characterized by growing market demands for quality and product delivery times, as well as by an increasing pressure of costs due to steadily stiffening competition. Thus, the need arises in the production area to use more efficient automated production techniques as well as to improve planning and control of the production process by using computer-based production control systems.

An increase in the efficiency of production control has an immediate effect on significant enterprise goals such as readiness to deliver goods, use of capacity, and processing time. This can be clarified by an example: For a mid-sized enterprise with DM30 million annual volume, DM10 million in production costs, and DM7.5 million worth of goods in process, an improvement of 2 percent in capital utilization represents, for production efficiency remaining constant, a decrease in annual production costs of DM200,000. A shortening of the production time for each work process from 5 to 4 days makes possible a decrease in the stock of goods in process by DM1.5 million and thus a savings in costs of capital by DM150,000 per year.

In pursuit of the goal of efficient production control, numerous enterprises today use several forms of EDP-based [electronic data processing] production control systems. An evaluation of the effectiveness of such systems, especially as the basis for investment decisions, has been quite problematic in practice.

A research institute for efficiency (FIR) of the Technical University at Aachen has developed a classification system for EDP-based production control systems that can perform comparative effectiveness calculations to solve this problem. (A detailed presentation of this work can be found in the book by M. Wiese, "Wirtschaftlichkeitsbeurteilung EDV-gestuetzter

Fertigungssteuerungssysteme" [Effectiveness Assessment of EDP-Based Production Control Systems], Berlin, E. Schmidt, 1979.) The term "production control system" includes all three components--the scheduling system, the feedback system, and the information system.

By using the two classification features, planning frequency and degree of freedom in carrying out production, a number of distinct and different basic types were defined. These were further subdivided according to significant criteria bearing on effectiveness: On one side, the procedures for production control tasks, as the decisive quantity for determining the efficiency of the production control system, and, on the other side, the hardware required, as the determining factor for the size of investment required for the system. About 50 practical application cases falling in the 5 essential basic types (Figure 1) were identified in this study by using the described features.

Schedule and Capacity Planned by Computer

Basic type 1 is characterized by a weekly planning frequency and by the great degree of freedom in carrying out production. A computer is used for schedule and capacity planning; problems of factory control, on the other hand, are solved only by production control personnel. Hardware required is a central planning computer. This basic type corresponds to the image of EDP-based production control systems predominant today.

Basic type 2 differs from the above-described basic type by daily replanning that considers feedback from production, which is done via an on-line operational data collection system.

For basic type 3, planning takes place at weekly intervals, as in basic type 1. The sequence of operations given within the framework of planning for equipment is, however, strictly adhered to. In order to track production progress, an on-line operational data collection system is used, such as for basic type 2. Feedback is processed directly in a decentralized production computer, which delivers actual information on the state of production and, when deviations from schedules occur, aids in rescheduling.

Basic type 4 is put together in a similar manner. In this system, the planning computer does rescheduling on a daily basis. Thus, for basic types 3 and 4, the control task and the planning are supported by EDP. The problems being handled by the computer can always take into account the actual state of production. This today still relatively seldom-encountered application of computers is also known by the term "real-time production control."

For basic type 5, all tasks connected with production control so far considered are carried out by EDP machines. Interference by personnel is, for all practical purposes, excluded. This basic type can be seen as the most far-reaching form of EDP penetration. Its application, however, will be limited to special uses, e. g., certain forms of process control.

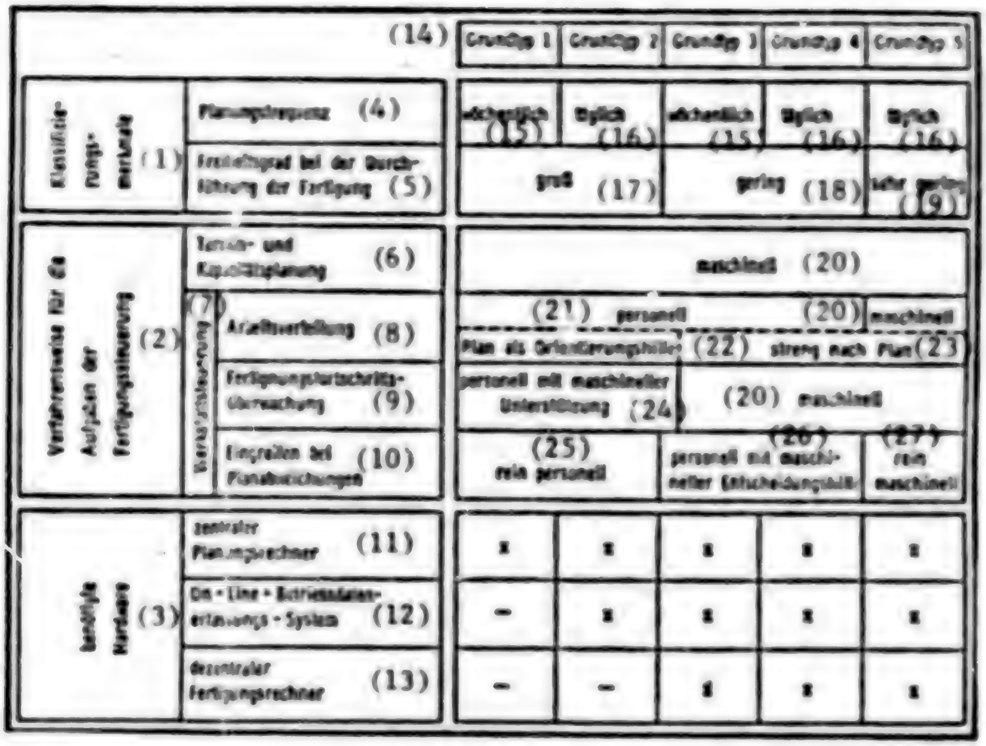


Figure 1. Characteristics of Basic Types of Computer-Based Production Control Systems

Key:

1. Classification features
2. Procedure for production control tasks
3. Hardware required
4. Frequency of planning
5. Degree of freedom in carrying out production
6. Schedule and capacity planning
7. Factory control
8. Work distribution
9. Production progress monitoring
10. Interference in case of deviations from plan
11. Centralized planning computer
12. On-line operational data collection system
13. Decentralized production computer
14. Basic type
15. Weekly
16. Daily
17. Great
18. Small
19. Very small
20. By machine
21. By staff
22. Plan used as reference
23. Strictly according to plan
24. By staff with machine support
25. Purely by staff
26. By staff with machine-based decision support
27. Purely by machine

The five basic types described represent the variants to be judged in a comparative effectiveness calculation. The effectiveness comparison made by the FIR on the basis of operating conditions in two large tool-manufacturing plants producing one-of-a-kind and small-series production machines can be used to make fundamental observations.

Simulation of Production Processes

The interesting comparison (Figure 2) that follows can be made on the basis of cost estimates supplied by manufacturers and also on operational experiences and an estimate of profitability by using simulation of the appropriate production operations (this method is necessary as there is no directly calculable relationship between a production control system and the goal quantities to be affected, such as capacity utilization and production time).

(1)	Grundtyp 1	Grundtyp 2	Grundtyp 3	Grundtyp 4	Grundtyp 5
jährliche Kosten des Fertigungssteuerungssystems (2)	600	708	605	658	920
jährliche Mehrkosten 1) (8) (3)	-	108	5	58	320
Einsparung der Kapitalbindungskosten 1) (8) (4)	-	0	29	29	1
Erhöhung der Produktionsleistung 1) (8) (5)	-	40	272	272	128
jährlich quantifizierbarer Nutzen 1) (6) 1) (8)	-	-68	296	243	-191
Rentabilität (%) (7)	-	-	27	22	-

Figure 2. Results of the Effectiveness Comparison. Entries given in DM1,000.

Key:

1. Basic type
2. Annual costs of the production control system
3. Annual additional costs
4. Savings in capital loan costs
5. Increase in productivity
6. Quantifiable annual gain
7. Earnings (%)
8. Difference from basic type 1.

Considering the total annual costs (personnel costs, EDP costs, interest costs, and so forth), basic types 1 through 4 are in about the same order of magnitude with costs of DM600,000 to DM700,000. A consideration of profitability, however, shows clear differences. Based on improved capacity utilization, the production efficiency for basic types 3 and 4, with production costs constant, is clearly increased. By considering the one-time start-up costs, the results for both of these systems with real-time production control yielded savings of 27 or 22 percent, respectively.

The effectiveness comparison made with the classification shows that substantial savings are possible by extending EDP support to factory control if it goes with a tight organization and is independent of improvements in nonqualifiable factors, such as transparency and ability to react. By using cost-effective operational data collection and information systems based on microprocessors, results of such an effectiveness comparison can, in the future, be made significantly clearer.

Use of Codes

Duesseldorf HANDELSBLATT in German 8 Oct 79 p 193

> [Text] The collection of actual data in order to maintain schedules better and to improve control of material, machines, and personnel in the production process directly is a data-processing goal in several industrial enterprises set for the 1980s. Data from orders with bar codes printed on them can be rapidly collected with a light-pen.

The collection of operational data by using graphics and special terminals not only entails a substantial hardware and software expenditure, but also demands a positive attitude toward the graphics terminal work, that is, entering of often large data quantities via the keyboard by the operators (foremen, chief clerks, and workers). Because terminal operators of operational data collection systems in general have neither qualification nor inclination for such tasks, many users are looking for a simpler and quicker collection technique.

Relief, no doubt, is brought by an optical reading of the order in conjunction with a display device. However, large demands are made on the reading of the order in a production operation, which cannot be satisfied in many branches. In most production facilities, there just is not a clinical atmosphere, and even small amounts of soiling of the orders can lead to erroneous interpretations when using OCR-B-clear script. This means, however, that in that case the entire identifier code (a typical length of over 20 characters) must be entered via keyboard.

The reading of the clear script through the scratched and dirty plastic covers that are common for work papers subjected to repeated use is impossible. On the other hand, the extraction of the paper is too time-consuming and uncertain in view of the possibility of loss or substitution.

The problem can be solved with more certainty and cost efficiency by using a bar code. Here the numerical values are represented as bars of varying width and arbitrary height. Soiled areas can be avoided when using the light pen. Also, reading can be done in either direction. Erroneous readings can be recognized immediately and repeated by using a self-checking numbering system.

Bar-coded orders are printed using a matrix printer on every factory order during the EDP preparation of the production records, and are kept in a plastic jacket with these records until the worker starts on a specific operation. The chief clerk then removes this work packet from his file, calls up the work distribution program on the graphics terminal, and enters the identification number by passing the light pen over the bar coding.

Reading bar codes has been successfully practiced for the last several months by a large German metal-processing enterprise employing 2,000 workers. The production of the enterprise usually includes 29,000 factory orders with some 130,000 work processes, of which about 55,000 are completed per month. Four out of a total of 29 display terminals have been equipped with a bar-code reader.

Once the first task has been accomplished, namely that of work distribution, i. e., the collection of data as to when and what worker and what machine will do what task, the second problem was tackled: The replacement of feedback cards, which were generated at the completion of individual work processes and delivered to a central EDP facility 2 or 3 times every day. A third area of application is final storage, where again, through reading of the bar code, the product is transferred from the "deficit" parts list to the "completed" parts list and the scheduling is erased. This application has also been started.

The actual collection of work process data directly during production contributes to improved information flow and schedule adherence, without burdening workers with having to make a thousand and more 20- to 30-digit entries each day.

This bar code, which can be read at a station for operational data collection by passing a light-pen over it, is printed by a matrix printer on the work records for every production order.

Software Discussed

Duesseldorf HANDELSBLATT in German 8 Oct 79 p 194

[Text] While modernization of production processes proper in both machines and procedures has made great strides, the accompanying organization is frequently still at the level of the 1920s: It works with manual card index files and expediters. Mid-size and small enterprises that are particularly counseled to get a grip on costs and, by increasing visibility, to adhere more closely to schedules and provide better customer service, should switch to a dialog with minicomputers.

Large enterprises that have been using large central computers for some time in production planning and organization have shied away so far from using near-real-time EDP in the professional area of the work preparer and foreman, which use would integrate the execution phase of production. The reasons are primarily communications problems: The data processing professional frequently does not know the specific requirements and does not speak the language of the production personnel, and vice versa. This leads to the refusal of any new organizational solutions out of hand.

Minicomputers have proved themselves for years in industrial applications based on their high capacity and efficiency, great flexibility, fail-safe operation, simple servicing (without operator), and competitive price. Thus, it is only natural to use them for a near-real-time dialog operation in the production and material-handling areas.

Such a solution, which has repeatedly been used in practice, is being offered by the design group of Systemtechnik GmbH, Bremen, among others, for the Wang minicomputer. The production control system is viewed as an integral component of the total operation management and includes, besides the production planning (parts list, work plan generation, and administration) and production control (preparation of production documentation and capacity loading), the following: Warehousing (status of inventory, determination of requirements, ordering, and preparation) and order processing with bid preparation and order monitoring, accounting, and auditing.

In this connection, the term "integral" means that all data, which at the place and time of their generation are directly entered by the worker into the graphics terminal, are immediately processed and retrievable in all areas. During data entry and information retrieval, the workers who are not experienced in dealing with the computer are guided by a refined dialog technique, which speeds up familiarization and reduces errors.

In order to consider the specific demands of a growing organization and in order not to have to adapt to the machine with unnecessary difficulty, the programming system for production control considers the various

peculiarities of individual production establishments, in which the decisive factor is not so much the branch of industry it is but the type of production (single or series production that is either material-, machine-, or labor-intensive).

Design, modular construction, and ease of system usage will provide implementation that is free of problems, rapid, and customized in all production enterprises. The frequently proposed 5- to 6-year period of introduction for integrated production control systems could thus become outdated. The investment for a minicomputer can be held within reasonable bounds and usually quickly amortized if one considers the high costs that would arise from uncontrolled warehousing, erroneous calculations, late or early production or improvisation during breakdown of personnel and machine.

Control of Precision Work

Duesseldorf HANDELSBLATT in German 8 Oct 79 p 195

[Text] Workers in precision design and production planning are very occupied with routine work in drafting. The Philips research laboratory at Hamburg has developed a programming system in cooperation with the Siegen/Eiserfeld plant of Philips Data System that makes possible graphic data processing in this field through the use of an interactive graphics terminal.

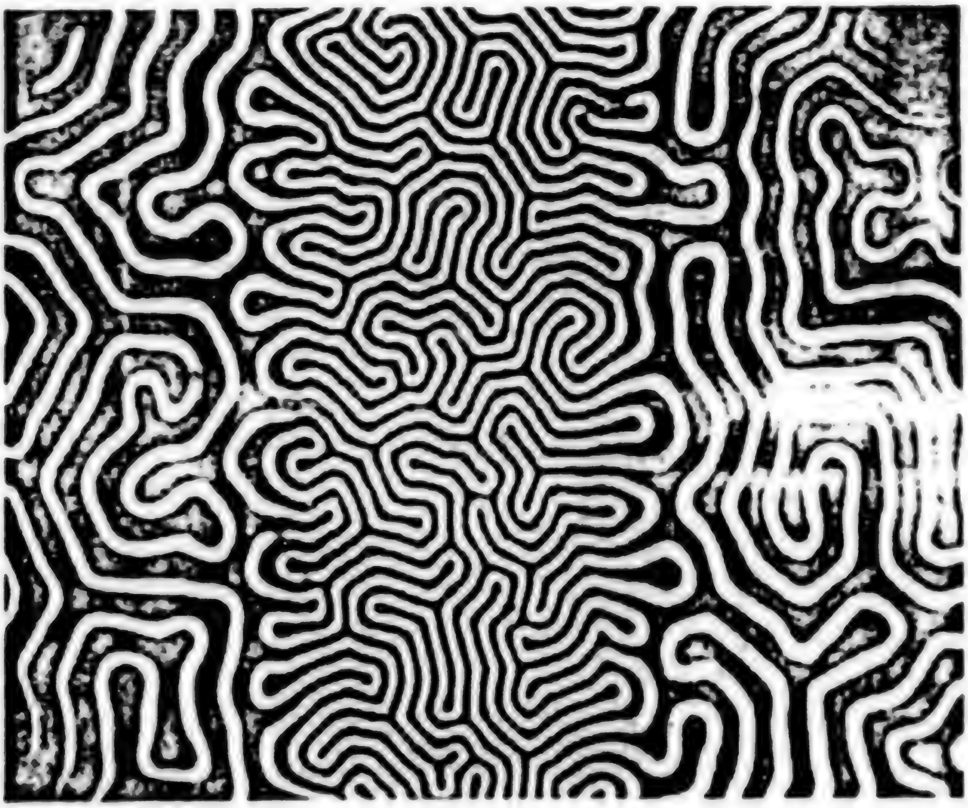
The first phase of the development of the programming system work was concentrated on practical presentation of turned and stamped parts. An image corresponding to the blueprint is interactively generated on the graphics screen. In contrast to the usual work manner at a drafting board, the image presentation is extensively automated through the call-up of descriptive elements with the aid of a light pen and an alphanumeric keyboard. At the same time, all data required for the reproduction of the designed part are stored in the computer and, when the work process is completed, are deposited in the component part file of a CAD [computer-aided design] data bank.

By accessing the data bank, subsequent work processes can be carried on either semi- or fully automatically, as for example, dimensioning of parts, joining parts in assemblies, and the generation of drawings by automatic drafting machines.

The component parts library of a data bank is further used for the parts change service, and simultaneously forms the link between design and production planning. Thus, for the CAD of stamping tools, the contour descriptions of the component parts to be stamped are used to compute automatically the segments of largely identical tool-cutting contours. Other tool data that are not dependent on the part geometry are called up from a tool macrolibrary during the design process, and data on the designed parts are stored in a tool parts library.

If additional instructions for NC technology are added on the screen, then this system will simultaneously produce all required data for numerical tool

machine control. Further development steps of this project will deal with additional classes of parts and processing procedures in the fields of casting, turning, or shaping. The basic version of this system has already proved itself in practice at the Eiserfeld plant.



"More intelligent" data processing requires efficient hardware. Such hardware includes memories with large capacity yet of small volume. A highly promising candidate for large mass storage is the magnetic bubble memory. Cells of this artificial memory consist of cylindrical magnetized regions (bubbles) in a thin film made of garnet. Researchers keep trying to grow memories with ever-smaller bubbles in order to increase storage density. The figure shows a garnet film that has been treated with a laser beam, in which it was possible to create smaller (and yet stable) bubbles than in the untreated film.
(Picture credit: IBM)

6948
CSO: 3102

INDUSTRIAL ENERGY CONSERVATION TECHNIQUES EXPLORED

Graefelfing ENERGIE in German Nos 8/9, Aug/Sep 79 "Industrielle Energie-Technik" Section pp 110-114

[Article by G. Baller]

[Text] It is well known that, of the total terminal energy purchased in the industrial area, on the average, only about 55 percent is converted into useful energy. Types of useful energy are heat, mechanical energy, light, and useful energy for physical/chemical processes (e.g. electroplating). About 45 percent of the paid-for energy are therefore to be accounted as losses, in the conversion, transport, distribution, storage, and application of energy. Naturally, part of these losses is unavoidable for purely physical reasons. However, a considerable potential for savings remains which should challenge every operations engineer.

As a result of the price development of energy, many businesses are developing previously unknown starting points for efficiency measures. Appropriate attention was always paid to the energy cost factor in energy-intensive production branches. However, the economic limits for energy-saving investments are shifting with the tempo of energy price increases. This development does not find energy-intensive businesses generally unprepared. On the basis of their previous concern with this problem, such businesses have gathered appropriate knowhow and have available qualified employees. However, the predominant number of businesses more or less suddenly find themselves constrained - or find the opportunity - to increase the efficiency in an area which previously was ranked under the heading of "auxiliary materials". The shock of the second oil crisis is more profound and prominent, since it made clear to everyone that not merely an "oil price crisis" was involved, but a foretaste of future scarcities. The political or national-economic situation in a few supplier countries already today can lead to pointed energy scarcity and consequently to acute bottlenecks in production. Because there are no surpluses in petroleum products, the market mechanism is disturbed. If one believes the forecasters, this will entail further price increases. This is sufficient cause for every business to consider how not to become energy

cost intensive, even if the production methods of the business are not intensive in energy consumption.

Develop energy savings methods in a team

Competitive advantages are most easily attained where changes in the business area occur most drastically or quickly. This is especially true for rapidly growing or changing markets, in which active businesses with appropriate product policy and marketing strategy will be successful. This holds for severely rising personnel costs, which were counted with capital-intensive production equipment and increased automation. Similar chances today appear in the energy area. In nearly all businesses, considerable efficiency potential already exists, and its further growth is foreseeable. It can be utilized by employing brains and naturally also capital.

To preclude misunderstandings from the very start: No longer is the point merely to improve the conditions of energy acquisition nor solely to optimize operational energy supplies. A design for a more efficient energy use starts with the origin of energy consumption, namely the process. If business managers will pardon, it first of all calls the process into question. For this reason, there can be no "energy consultant". More efficient energy use can be designed only in a team. Theoreticians and practicioners, energy engineers and the corresponding process and production engineers must jointly seek for improved or new solutions. The starting point for all considerations is a systematic energy flow and - especially - an analysis of the demand for useful energy. Only in this way, will it become clear how much energy is frequently utilized for so little actually acquired useful energy, and where the savings potentials might possibly lie. The above-mentioned, sometimes scarcely credible 45 percent loss will then suddenly become plausible. The analyses will be based on measurements of various component energy flows. They will indicate the most promising starting points for efficiency measures. The large energy consumers are not always the ones where lucrative improvements are possible. Energy savings potential and technical-economic implementability are also decisive.

Find weak points

If the "energy" is pursued from the location where useful energy is applied, back to the point where the energy supplier takes over various terminal energy media, the following reference points result for reducing energy consumption and energy costs:

Reducing the demand for useful energy, that is, for example, reducing the process temperature; heat insulation at reactors, baths, cooling chambers and the like; increasing mechanical drying at the expense of thermal drying; using radiating heat, microwaves and induction heaters.

Avoiding unnecessary demands for useful energy, e.g. temperature differences depending on surface use; avoid the consumption of light, power and hot water, if there is no real need; improve the loading of furnaces, baths, etc., by means of control measures; heat insulation on pipe lines.

Improve the efficiency of energy conversion, that is optimal adjustment, maintenance, or possibly replacement of boiler systems; utilization of lamps with higher light yields; improved efficiency of speed-controlled drives and in the generation of direct current.

Energy recovery, that is e.g. heat recovery from chimney gases, waste waters, and exhaust air, in some circumstances in combination with heat pumps.

Utilization of unconventional energy sources, that is e.g. utilization of waste materials for energy; in special cases, also utilization of solar energy.

An energy flow analysis and an energy balance sheet serve several functions: they eliminate the complex system of the energy supply of a business with its different conditions in daily, weekly, and annual cycles, taking into account the respective values of the energy. They uncover weak points and thus provide the basis for more efficient energy use. Only on this basis, can one instigate considerations regarding the optimization of business energy use and regarding the reduction of specific energy costs. This can be achieved, for example, by the following methods:

Reduction of peak powers, e.g. by control, monitoring, or interlock measures using longer time constants with heat consumers, cooling systems, compressed air generators.

Checking the tariff situation with line-bound terminal energy media, checking the compensation measures for electrical current and, in connection therewith, the possible choice of alternative final energy media, that is e.g. substitution of oil; requisition of remote heat; utilization of force-heat coupling; utilization of steam engines, etc.

Don't think only for the short term

The energy design worked out in this way cannot always be implemented in the short term. A series of measures are economical only by accumulated efficiency effects. This is especially true in the area of production processes, where changeovers strive for quality improvements, reductions of personnel expenditures, and energy savings. Such changeovers are possible only under certain boundary conditions, such as possible product changes, plant replacement because of technical depreciation, movement of business sections or whole businesses. The energy design should be conceived in the medium to long term and should take into account the measures planned in all other areas. Likewise, inversely, changeovers required for

all other reasons, new installations and new construction, are ideal starting points for consolidating the energy economy and energy technology of the business, which must be used under all circumstances. As a rule, energy savings can here be realized with significantly less deployment of means.

The operational energy design should also contain an energy consumption and cost monitoring system in the sense of an energy control. In most businesses, energy cost should offer a more profitable starting point for control measures than telephone or copying costs, which often are the object of greater attention. Depending on the size, structure, and product spectrum of the business, energy consumption areas should be established, with specific responsible persons, in charge of energy costs, through causally oriented distribution keys and, wherever possible, through measurement points. Integration into the business cost accounting is possible just as is the installation of an independent system.

Government support

From the point of view of the business, activities for reducing energy consumption have the sole objective of cost reduction. In particular cases, other perspectives might be added, possibly avoiding the expansion of existing supply systems, which otherwise might be necessary, or increasing supply reliability. But from the perspective of the national economy, reduction of energy consumption occupies the foreground for various reasons. Consequently, the government promotes activities for more efficient energy use, by means of a series of programs.

In the Federal Republic of Germany, about 40 percent of energy consumption involves the heating of buildings. Consequently, this was the first focal point of the modernization and energy savings law. This funding program, however, refers exclusively to residential buildings and to buildings of juridical persons, who are not subject to corporate tax.

The following programs, however, are of interest for the business economy:

Promotion of consultation and information for small and medium businesses: guidelines and information through the trade chambers, industrial chambers, chambers of commerce, as well as guidance agencies, which are predominantly connected with the respective associations.

The program for energy savings in business, guidelines for promoting consultation and information of small and medium businesses concerning measures for energy savings; information to the trade chamber, industrial chamber, and chamber of commerce, or guidance agencies.

Program for promoting accelerated introduction into the market of energy saving technology and products; information to the Federal Ministry for Economy, Committee III A 6, Bonn.

Program on energy research and energy technologies 1977 to 1980. By means of this program, the Federal Ministry for Research and Technology (BMFT) promotes technologies for the more efficient and economical use of energy in the user and secondary areas. Details are explained in the relevant publications of the BMFT, which can be obtained from the committee "Press and Publication Work".

Investment support in the amount of 7.5 percent for certain plant, equipment, and expansions in connection with heating plants, solar systems, wind power systems, and heat recovery systems; information from the Federal Office for Commercial Business, Eschborn.

Credit and guarantor programs by the federal government and the provinces, which also include energy savings measures under certain conditions; information from the respective economic ministries for banks.

However, all these programs can only offer stimuli and certain assistance. What is required is a business decision to use the growing efficiency opportunities consistently in this complex area and not to be satisfied with individual measures. The area of business energy management and engineering is a complex one, because, in the final analysis, all business areas are touched:

production methods and, in some circumstances, the product itself

production sites and management buildings

preparation of the work and production control

supply and disposal

business accounting and purchasing

Be careful with "energy consultants"

In only a few businesses would it be possible to delegate appropriate specialists from all these areas to one working group, and even then success is not guaranteed, since the colleagues will usually not be familiar with the topic and appropriate experience will not be available. Small and medium businesses are particularly affected by this problem. Consequently, the abovementioned programs for supporting external consultation were set up. However, one must not yield to illusions: successful energy consultation requires the use of qualified engineers and specialists for measurements, analyses, and designs. This has its price. The program for energy savings in business affords at most 310.00 DM per day for at most 20 working days. Only businesses with previous years sales up to 20 million DM are eligible for funding. The businesses are therefore forced to invest in consultation without any precise knowledge of the result. "Guaranteed" savings will not be quoted by a serious

engineering enterprise. At best, a non-binding estimate will be given, based on a short analysis. The possibility still remains to ally oneself with "energy consultants" who will charge a relatively small lump sum, and then will "only" participate to a certain percentage, possibly over several years, in the resulting savings. These savings will be demonstrated to the business - by the energy consultant. This is not only problematical, as the load or production structure changes, but can also be very expensive in some circumstances. The "cost-free" consultation from supply firms should also be regarded critically, just as support in the development of optimized supply concepts, without previous energy demand first being basically questioned and minimized. A saving of one part useful energy, with an average ratio of 55 percent useful to 45 percent unused energy, effects a reduction of nearly two parts in the purchased terminal energy media.

The prospects certainly are that energy prices will continue to rise. Consequently, the efficiency potential of energy, which up to now has not been systematically exploited, continues to grow. Business energy use and supply concepts touch many areas in the business. They can be worked out only in collaboration between technical experts of various disciplines. These experts must come from the business itself, but they can also be partly or completely procured from the outside. The choice of a qualified engineering consulting and planning business is here of primary importance.

8348
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NUCLEAR FACILITIES TO TEST HEAT TRANSFER BEGIN OPERATION

Duesseldorf BRENNSTOFF-WAERME-KRAFT in German Jul 79 p 271

[Text] Within the framework of the Long-Distance Nuclear Power Project, the test facility Eva I/Adam I was officially put into operation in mid-May at the Juelich Nuclear Research Plant, GmbH (KFA). With the hooking up of the systems Eva I and Adam I effected here, another step has been successfully taken in the development of this new kind of energy transport system, which is based in principle on the transport of chemically bound energy in a closed loop. The project is being pursued jointly by the KFA and the Rhine Brown-Coal Works AG, with support from the Federal Ministry for Research and Technology as well as from the Land of North Rhine-Westphalia. The development goal is a long-distance nuclear power system whose source of energy is a high temperature reactor.

In a press conference on the occasion of the startup of the test facility, employees of the KFA gave information about the project's underlying principle, state of development, and application aspects. By way of introduction, Professor Beckurts, president of the KFA, emphasized the advantages with respect to our power supply of the long-distance nuclear power system--whose commercial establishment in this century, however, can scarcely be anticipated. The flexibility of the system--transport distances between reactor and consumer centers of 70 to 150 kilometers can be realized without heat-energy losses--holds out promise of a high energy utilization and economic efficiency. Decentralization would offer a way out of the present difficulties connected with using heat generated by nuclear power directly in conjunction with a total-energy scheme. As is known, the possibilities of substituting for petroleum by this means are very slight: The difficulties encountered in the long-distance transporting of hot water limit this direct utilization to areas of urban or industrial concentration, in whose vicinity nuclear power plants cannot be built.

The principle of the energy transport system Eva/Adam was outlined by Professor von der Decken: In a high temperature reactor, where energy is available in the form of heat, this heat is transformed into

chemically bound energy. This happens through a chemical conversion of one gas into another, higher-energy gaseous mixture. The high-energy gas mixture can be transported at ambient temperature over great distances in conventional underground gas pipelines. In the consumer centers, the chemically bound energy is then liberated again as heat, through reconversion of the transported gas mixture into the original gas, and according to requirements it is subsequently used directly for heating systems, for the generation of process steam, and/or for the generation of electric power. The regenerated original gas is conveyed back to the primary energy source in a second gas pipeline.

Among the many reactions which are possible in principle for the realization of an energy transport system, the reaction system was chosen which consists of the reaction of methane and hydrogen to yield carbon monoxide and hydrogen (methane reforming), together with the corresponding reverse reaction with the formation of methane (methane generation), Figure 1. In this connection, decisive factors were:

- the fact that all the co-reactants are gaseous and that a simple energy transport having a comparatively high energy density can take place;

- the fact that the operating conditions of the chemical transformation processes for heat capture and liberation are very well suited to a large-scale utilization, and that they allow a multiform utilization of the transported energy;

- the fact that the reaction of methane reforming has been performed industrially since the 1930's, and that there are initial experiences already for the reaction of methane generation.

As for the state of development, Professor von der Decken explained that methane reforming has already been tested under commercial conditions since 1972 in the Single Slit-tube Test Facility (Eva I).

The methanization facility Adam I was built in 1978/79 on a matched order of magnitude, and it has now been hooked up for the first time with the reforming facility Eva I to make an energy-transport system. In Eva I, the heat is added to the reaction between methane and hydrogen to yield carbon monoxide and hydrogen by way of electrically heated helium (heated to around 1000°C). After transporting the cold product gas (CO, H_2) over a distance of 20 meters to Adam I, this heat is again recovered at a temperature of up to 600°C, with regeneration of methane. The product gas of Adam I (CH_4) is now conducted back to Eva I as its input gas. With that, the loop is closed.

During the successful 4-week trial operation in the spring of 1979, it proved possible to transport 300 kJ/s (300 kW) of heat from Eva I to Adam I under design conditions. This first test showed, among other things, that the methanization process is feasible at temperatures of up to 600°C and that closed-loop operation can be realized by recycling the product gases from the test facility Adam I back to the test facility Eva I.

The testing program, which extends over several years, will now test various systems for the generation of methane and for heat release, will investigate the system with respect to accidents and load changes, and will analyse the dynamic behavior of the composite facility. In doing this, the concern is also to transfer the findings made to the large-scale testing and demonstration facility Eva II/Adam II, whose initial startup is already planned for the end of 1979. Here, the heat transport process is demonstrated by means of an input power of 10 MW, in connection with which the feeding in of power is still done by way of an electric current--as is also the case with the test facility I. This large-scale test facility is the last step prior to the building of a nuclear prototype facility at the KFA.

Dr F. Engelmann gave information about application-oriented aspects of long-distance nuclear power. Its independence from fossil-fuel raw materials was especially emphasized, since after a one-time filling of the system, substantially no more gas is consumed. Correspondingly, rising raw-material costs do not lead also to an increase in the heating price per calorie. Other positive features of the system: The high level of gas-transport technology, which among other things gives great flexibility in the selection of sites, and which allows the building of a composite center which can be expanded without difficulty.

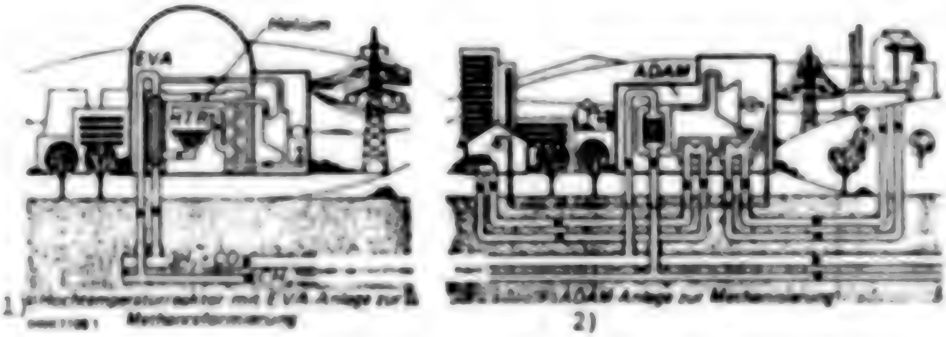

Figure 1: Long-distance Nuclear Power System Eva/Adam

Key: 1. High temperature reactor with EVA facility for methane reforming
2. ADAM facility for methanization

12114
CSO: 3102

FEASIBILITY OF LONG-RANGE HEAT TRANSFER EXAMINED

Duesseldorf BRENNSTOFF-WAERME-KRAFT in German Aug 79 pp 334-336

[Article by E. Windorfer, Duesseldorf: "Accelerated Development of Long-range Heat Supply Systems--Utopia or Real Possibility?"]

[Text] The problems connected with the initial phase in the construction of a long-range heating supply, the dependence of its expansion on the price level, and accompanying measures for accelerating customer hook-up activity are described. Shown as an example of a rapid construction of such a system is the long-range heat supply system of the city of Flensburg.

Introduction

The thought of harnessing the large quantities of waste heat generated by power plants for supplying heat to the cities in the FRG has come into the discussion anew since the oil price crisis of 1973/74. A very broad spectrum of opinions has formed which on the one hand has extended as far as advocating the development of a nationwide long-range heat transmission line, and on the other hand has gone as far as the complete rejection of this technology. With the "General Study on Long-range Heating" [1], which was ordered in 1974 by the Federal minister for research and technology and which was completed in 1977, it proved possible to bring order into this spectrum of opinions and expectations in many respects: Although the possibilities of supplying long-range heat are limited, especially on the basis of combined heat and power generation, within the limits which the study has indicated these possibilities are quite real, even from the standpoint of business profitability. Important assertions made by this study were:

From the point of view of the years 1975/76, the limits to profitably supplying long-range heat in the FRG are about 4 times larger than the scale reached in 1975/76. And this feasible maximum volume, which is based on certain premises, enlarges by yet another third if the price level for primary energy goes up by 10 DM/Gcal [gigacalories] (adjusted for inflation) in comparison to the situation in 1975.

In the setting up of a long-range heat supply system, what is very important in the individual case is to get over the financially difficult construction phase.

Whereas the assertions of the study concerning its economically proper capacity, which were made under precisely defined assumptions, have been given a great deal of attention--and in this connection they have even been misinterpreted at times as a prognosis--the results of the study are less well known on the question of how to cope with the initial phase of a long-range heat supply system.

Initial Phase of Long-Range Heat Supplying

Because of the heavy capitalization required, the initial phase in a long-range heat supply project demands special attention. The problem of the starting period lies in the fact that in the generation and distribution sectors, advance work must be performed which can be taken advantage of only after the passage of some years--in the most unfavorable case, even only after decades. Therefore, there are no proceeds which can stand over against the service of capital for the advance work for a certain period of time--something which can lead the enterprise to being "in the red" for a number of years.

The initial phase of a long-range heat supply system is an optimization problem, in which it is important to keep the sum total of the initial losses as small as possible. But in doing this, an additional condition is to ensure the liquidity of the undertaking. In this connection, enterprises whose operational branch of long-range heating is run conjointly as one among several branches have an easier time of it than enterprises in which supplying long-range heat plays the dominant role. Also, it is easier to further develop an existing long-range heating supply system which has already gotten over the initial phase than to begin a long-range heat supplying from scratch. In any case, what is essential is to shorten as much as possible the initial (or expansion) phase, in order to bring the project quickly into a condition of breaking even over the course of the year.

The marketing activities of the enterprise take on a paramount importance in this phase, so that the volume of proceeds can be built up--something which is necessary in order to achieve an annual break-even condition. What is important is to make certain that a high percentage of the potential customers is connected up as rapidly as possible to each newly laid location line.

The most important prerequisite for successful marketing activities is a competitive price per calorie. In the "General Study on Long-range Heating," average proceeds for long-range heating of 50 DM/Gcal were assessed in connection with those enterprise models which were examined for the initial-period investigation--proceeds which were considered

to be realizable on the basis of detailed investigations of the chargeable price at that time (with prices for extra-light heating oil of 27 to 30 pfennigs/liter).

In what way the feasible customer hook-up development is a function of the heat price offered by the enterprise can be judged only in light of local conditions. But there seems to be a sort of maximum development which cannot be exceeded for a given price per calorie.

In Figure 1, the connected-load additions which were reached between 31 December 1973 and 31 December 1977 for a rather large number of long-range heating enterprises have been plotted against the heat price (1976). The connected-load increases were relativized here, and in fact the potential for economical long-range heating (upper limit) of the city concerned was chosen as the reference figure, in accordance with the General Study. (Let us remark here, in answer to the question of why just this reference figure was chosen, that a comparison of absolute increases would have been pointless because of the differing magnitudes of long-range heating. Also, a comparison of growth rates--relative to the status at the beginning of the period of observation--would not have been very revealing because of the differing conditions of development of the individual long-range heating systems).

The remarkable thing about Figure 1 is that all the points lie below a limit line which intersects the abscissa at about 59 DM/MWh--that is, any heating which would cost more than 59 Dm/MWh (around 69 DM/Gcal) could not be sold as a practical matter, under the conditions of competition at that time (1974 to 1978).

To be sure, the figure also shows that many enterprises have not exhausted the potentialities offered to them by their charged price, for which there may be manifold reasons in the individual case. Of course, the marketing activities of the enterprises compared here varied greatly. But the figure makes it clear that even the most extensive marketing activities are of little use if the price per calorie is not appropriate to the given competitive situation, which is determined by oil and natural gas.

Thus, an accelerated expansion of a long-range heating supply system seems possible only on the basis of suitable per-calorie prices. Therefore, before the beginning of each and every major long-range heating project, a careful examination must be made as to whether the sufficiently low price for long-range heat which is required on marketing grounds seems to be realizable from the standpoint of costs. Let us only mention here the opportunities for influencing the costs as well in the development period.

In connection with the development situation, again and again the catchword "compulsory hook-up and use" is heard. Here we must

distinguish--on the basis of the prevailing law--between a private-law hook-up obligation and the legal machinery of compulsory hook-up and use which is based on municipality by-laws. The private-law obligation to allow hook-up is based on the fact that the seller of a piece of land (for example, the municipality) obligates the buyer to connect up his buildings to the district heating system (under construction). Use is made of this possibility frequently in connection with the construction of self-contained new-building areas, which have sprung up in great numbers in the post-war period. Today, the private-law hook-up obligation has only minor significance, because entire satellite towns are springing up only seldom. In old-building areas, only the public-law compulsory hook-up and use mechanism based on municipal by-laws is possible--if even then. But according to prevailing law, this may be applied only for reasons of environmental protection. It is not an instrument which could serve the purpose of soliciting customers for an otherwise not economically realizable long-range heat supply system.

The long-range heating sector--as far as can be seen--views with reservations the application of this legal instrument. Compulsory hook-up and use signifies an encroachment on free-market mechanisms, and it triggers an interference by the public authorities in business activity.

Although the current State support which is being given to long-range heat supply systems in many localities in the form of investment grants likewise signifies an encroachment on free-market mechanisms, in each individual case it is only given once and is merely subsidiary support, having the effect of facilitating the construction phase for the long-range heating enterprise. The freedom of both the customers and the enterprise to make decisions remains unaffected in such cases.

Long-Range Heat Development in the City of Flensburg

A convincing example of the accelerated construction of a long-range heat supply system under free-market conditions was presented at the last annual conference of the AGFW [Association for Long-range Heating] in Flensburg [2]. In the period from 1969 to the end of 1978, the public utilities of Flensburg have set up a district heating system having a total connection load of about 420 MJ/s--and this has been done in a city whose construction resources and topography would be characterized in many places as not very suitable for long-range heating, because of the small heat output density. The total length of the mains which was reached at the end of 1978 was given as 180 kilometers, and the extent of consumer hook-ups along the location lines was stated to be 85 percent, relative to the potential suitable for long-range heating.

This success was achieved with mains installation costs which even lie below the lower limit of what was considered to be realizable in the FRG

in the "General Study on Long-range Heating," Figure 2. Serving as a heat source is a heat and electric power plant, which is fired predominantly by imported coal. One of the decisive inducements for this rapid customer hook-up development can be seen in the heat prices of the enterprise, which even today (1979) are below 35 DM/MWh, and thus lie at the extreme lower edge of the spectrum of prices for long-range heat in the FRG, Figure 3. But another decisive inducement can also be seen in the fact that the gas-supply system in Flensburg does not represent any real competition to long-range heating, because Flensburg does not now have any natural gas and will not have any for a while. Although no detailed particulars are given by the enterprise about the economic efficiency of the operational branch of long-range heating (by itself alone, in the sense of a disclosure of the profitableness of its development), it is indeed stressed that the enterprise as a whole has not gone into the red because of its development of long-range heating, even though the losses of the transport operations, of the fading gasworks, and of the port operations had to be made up for from the surpluses of the remaining operational branches of electricity/long-range heating and water.

Figure 4 gives a summary of the financing of the total project, inclusive of the heat and electric power plant. The graph also includes the investments for electricity distribution, amounting to about 10 percent. It is noteworthy that the fraction representing subsidies given by the public authorities, at around $41 \cdot 10^6$ DM, constitutes a share of only 13.6 percent, given a total volume of $300 \cdot 10^6$ DM. The subsidies thus remain on a modest scale, which one can designate without the least hesitation as "pump-priming aid" for the project. Given this order of magnitude, any suspicion that here a lasting uneconomic condition perhaps has been hidden by subsidies would be certainly unfounded. As for the rest, the graph also shows that the city of Flensburg, as owner of the enterprise, has contributed its share to the financing of the project, on about the same order of magnitude, through increasing the enterprise's capital resources.

The setting up of a district heating system of this magnitude within a time of only 10 years must be acknowledged to be a business achievement. Such an achievement would not have been possible to the leadership of the enterprise if it had not had the necessary backing from the community supervisory bodies. Thus, it is a collective achievement of the enterprise and the enterprise's owner. The long-range heating of Flensburg is also a good example of what is attainable when the forces which are active in the locality concentrate jointly on a goal.

Although such a business achievement is not reproducible everywhere in the FRG in the same manner--if one considers the marginal conditions--it nevertheless shows that an accelerated development of a long-range heating supply system is by no means a utopian dream. The Flensburg example might be inviting as worth emulating in case oil and natural gas become really scarce.

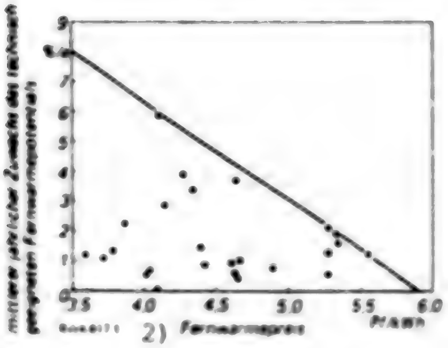

Figure 1: Growth Rates Relative to the 1990 Potential for Technically Suitable Long-range Heating, According to "General Study on Long-range Heating," as a Function of the Price for Long-range Heating (Status in 1976)

Key: 1. Average annual growth of technically suitable long-range heating potential
2. Price for long-range heating

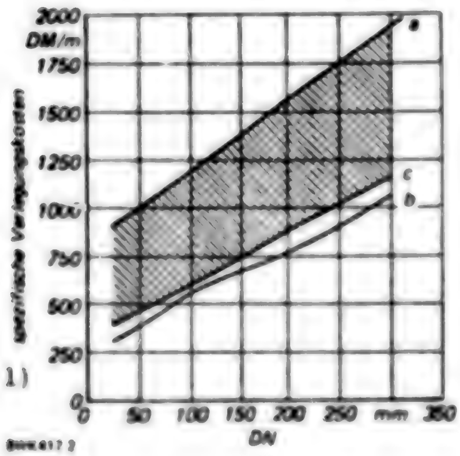

Figure 2: Comparison of the Specific Installation Costs of Hot-water Lines in Flensburg With Those of the "General Study on Long-range Heating" of the BMFT [Federal Ministry for Research and Technology] (Status in 1975) [2]

a Limit of upper range in the "General Study," inclusive of an allowance for areas of high heat density

b Limit of lower range in the "General Study"

c Average installation costs in Flensburg

Key: 1. Specific installation costs

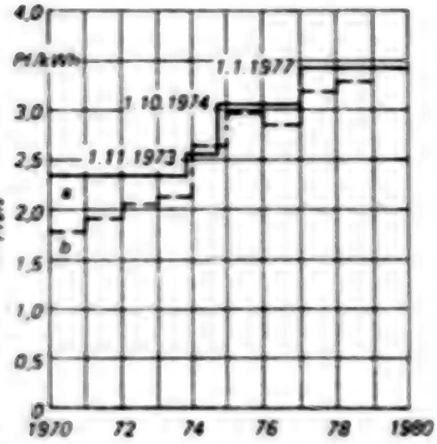

Figure 3: Long-range Heating Prices and Proceeds of the Flensburg Public Utilities (not including sales tax and contributions to building costs) [2]

a Normal charged rates for 1,500 hours/year

b Average effective proceeds

Key: 1. Price

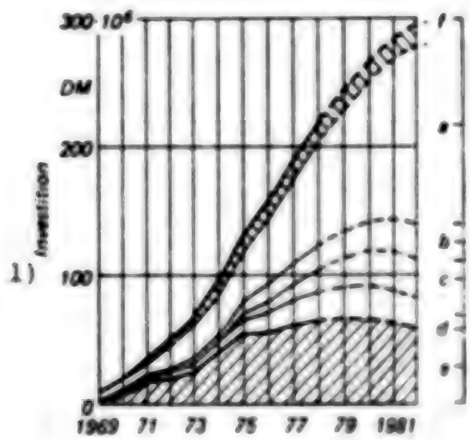

Figure 4: Accumulated Investments Since the Beginning of the Heat and Electric Power Plant Project, as Well as Medium-range Financial Planning for Generation and Distribution Systems for Electric Power and Long-range Heating Supply [2]

Financed through:

a Depreciations, inclusive of special depreciations allowed for zonal border areas

b Accumulation of capital reserves

c Other allowances, such as: §4a/b: Investment Allowance Law, Third Electricity-from-coal Law, Program for Future Investments

d Contributions to building costs by customers

e Loans

f Reserves

Key: 1. Investment

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[2] Prinz, W. "The Flensburg Energy Concept," informational brochure of the Flensburg Public Utilities, distributed at the annual conference of the Association for Long-range Heating, e.V. (AGFW) of 10 May 1979; see Reprint No 3117 of the Long-range Heating International-FWI.

12114
CSO: 3102

STATES CONSIDER NEW COAL-BURNING TECHNOLOGIES

Graefelfing ENERGIE in German Jul 79 pp 228-229

[Excerpts] With his desire for an increased use of coal, Chancellor Helmut Schmidt is forcing an open door in Berlin. This insular state, which in any case is shut off from all sources of primary energy, has already decided to make provisions for the expected increase in requirements in the electricity sector through the building of additional coal-fired base-load units. The Berlin Senat sees the future as lying in coal: "The proportion of plants operating with petroleum products must be reduced, in order to more completely decouple the electric-power supply from the imponderables of our petroleum supply." In this connection, the resolute expanding of long-range heating systems is being heavily stressed in the energy policy of Berlin, and new ecologically safe technologies such as the fluidized-bed furnace are already an element of Berlin's deliberations with respect to coal.

The Land government of Bremen is in agreement with those in Hanseatic Hamburg as much as with Holger Boerner's Hesse: In these areas there are no special programs for coal.

In North Rhine-Westphalia, as of now things are going full tilt with respect to coal. Economics minister Riemer is having his grand hour. If impure intentions had been imputed to this FDP man in the past, in that his approval of coal was looked upon as only vote-getting and supposedly had little in common with the national economy, nevertheless today Riemer is reinstated. Whether it was only luck or also ability, Riemer's insistence on coal has proved to be right. Nobody asks any more whether it was farsightedness or only mere election-campaign tactics--the prophet is once again with honor in his own land. Wherever something is going on concerning coal, there Riemer moves as well. Ground-breaking ceremonies such as in connection with the planned coal liquefaction plant in Bottrop have become a sportsmanly routine action for this minister. Of course, along with this activity there is really a lot of hot air as well--in any case, this is the opinion of the opposition leader in the Duesseldorf Landtag, Heinrich Koeppler, who accuses the social-liberal coalition in North Rhine-Westphalia of

having a "policy on conveying information which can no longer be outdone in its untrustworthiness." In his charges, Koeppler dealt quite concretely with certain remarks made by Riemer, who in mid-July announced the construction of huge hydrogenation plants. For about 3.5 billion marks of capital costs, according to Riemer's assertion, the supplying of power on the basis of domestic coal could be realized. Koeppler's commentary on this: Pictures of the future are being drawn by the government which lack any really solid foundation; there are no plans for large-scale hydrogenation plants, let alone any concrete contracts with respect to project planning.

Yet even excluding this, Riemer has created an enormous framework of investments relating to coal in his Land. From mining safety to health protection, up to making gas from coal, North Rhine-Westphalia is busying itself with coal. From 1974 to 1978, this Land spent 377 million marks for an energy technology program, and when there is talk in North Rhine-Westphalia of energy, coal is what is meant. For 1979 alone, 326 million marks are coming from the fiscal purse in Duesseldorf, and in the coming years, Riemer is going to have tax mor / flow more than ever in order to make things all right again with coal.

The overall perspective of this Land government with respect to energy policy, according to Joachim Glomm, a spokesman of the ministry, "is keyed to four goals: Safety, independence, reasonably moderate prices, and ecological compatibility of the energy supply." At the present time, the social-liberals in Duesseldorf are pushing several individual projects:

Gasification of hard coal to make lean gas for the combined gas/steam turbine process.

The purpose of this project is to avoid expensive flue-gas desulfurization systems by pre-gasifying the coal and desulfurizing the generated fuel gas before combustion. With this gas, not only steam boilers but also superposed gas turbines can be operated. For this project, 133.7 million marks are earmarked up to 1982, of which about 73 percent is being borne by public funds. A 170-MW pilot plant near Steag in Luenen is to be followed by the planning of a major demonstration plant.

Generation and use of industrial gases from low-grade coal.

At the Sophia-Jacoba Mine in Hueckelhoven, a plant having a throughput of 15 tons of coal per day has been put into operation. The initial gasification tests have been carried out, and they should give indications as to the economic efficiency of large-scale plants. So far, 600,000 marks have been spent for the study of this system, of which 500,000 marks were furnished by the Land government as a subsidy. For the construction and operation of the demonstration plant, costs of 18.9 million marks have been earmarked.

Making of liquid products from coal by means of hydrogenation (coal oil).

The starting shot in plant engineering in the field of getting oil from coal was fired in Bottrop, where the first major test plant is being built (see box on page 245). Capital and operational costs will add up to about 300 million marks within a 3-year period of test operations. Of this amount, 270 million marks is being furnished by the Land of North Rhine-Westphalia as a subsidy.

And this is not all. In order to get a broader market for coal, Riemer has commited himself also to long-range heating, having spent 124 million marks from 1977 to 1978 for the program sector of "development of long-range heating in urban concentration areas." Riemer's Mr Glomm: "For a long time now, the North Rhine-Westphalia Land government and the North Rhine-Westphalia Landtag have demanded an intensified conversion of hard coal to electricity and a greater enlargement of power-plant output, especially with a view to securing a sufficient energy supply over the long range, and because of the delay in the development of nuclear energy." That is quite right, and it is also true that Riemer is in favor of nuclear energy only when it benefits the coal sector. For example, in connection with the high temperature reactor, in whose high temperatures the minister sees new glory for coal. Riemer has shown plenty of backbone for coal: The minister is accepting the responsibility for guarantees on the level of billions of marks for the Ruhrkohle AG and for several hard-coal power plants.

What Riemer has pushed forward in North Rhine-Westphalia is something that Saarland's late Minister-president Roeder did not neglect either: To preserve jobs and the hard-coal market. What is taking place in North Rhine-Westphalia in grand style is happening also in the Land on the Saar on a smaller scale. Mining director Redeker of the economics ministry in Saarbruecken cites the second updating of the Saarland Energy Program of 16 January 1979, and he points out in this connection that "domestic hard coal as well as the research and development projects for the conversion of hard coal" are being given "a broader scope." Coal gasification and coal hydrogenation are also on the research program, in association with the Saar Coal Mines AG. For these purposes as well as in the area of mining and power-plant engineering, the Saar Coal Mines AG intends to spend around 1 billion marks for research and development in the next 5 years. The people of the Saar have not yet managed to have it quite as good as their fellow miners in the Ruhr in terms of support from the Federal Government. Redeker: "The question of whether the Federal Government will financially participate in the construction of corresponding large-scale plants in Saarland, following a successful completion of the research and development work of the Saar Coal Mines in the areas of coal gasification and coal liquefaction, has not yet been conclusively clarified." At any rate, the Saar long-range heat transmission line, the model power plant at Voelklingen, flue-gas desulfurization plants, and the

technology center for coal gasification in Fuerstenhausen are being backed by Federal research minister Hauff. Money for these purposes is also coming from the Land government, which sees the time as arriving in the middle of the 1980's when transformation technologies for converting coal into gas and oil could be applied on a commercial scale.

12114
CSO: 3102

USE OF NUCLEAR POWER FOR COAL CONVERSION PROPOSED

Graefelfing ENERGIE in German Jul 79 p 2(4

[Text] Only through a suitable combined action of coal and nuclear energy can the problem be solved of a secure energy supply in the late 20th century. That is the tenor of the 12 theses on coal conversion which are defended by the largest German reactor manufacturer, the KWU [Kraftwerk Union].

Despite rich coal deposits, today almost 60 percent of our needed primary energy is imported. Because in the condition in which it is mined, coal is suited almost exclusively only for burning in boilers and blast furnaces. In order to get at the locked-in hydrocarbons and to develop new spheres of application, expensive and energy-intensive techniques are required. Thus, in the autothermic coal conversion process, a large part of the coal must be burned in order to generate the energy which is needed for the transformation into the desired products. On the other hand, if the high temperature reactor is used, then the entire coal input can be converted.

Today, the development of new large-scale technologies requires 10 to 20 years. In order that by the end of this century no gaps may appear in our energy supply, the energy-policy decisions in this area must be made now--so says one of the KWU theses.

Nuclear Energy--Cheaper in the Base-Load Range

That is the finding of a study comparing electricity costs between coal and nuclear energy which was carried out by the Battelle Institute on behalf of the Land of North Rhine-Westphalia.

If indirect costs are ignored, nuclear energy has a price advantage of 3.27 pfennigs/kWH in the base-load range (7,000 hours/year) and an advantage of 1.96 pfennigs/kWh in the intermediate-load range (5,000 hours/year). Only in the peak-load range (3,000 hours/year) is electricity generation with coal cheaper, by 2.02 pfennigs/kWh. The study compared power plants of the type Biblis C and the Voerde type.

Employed as the cost accounting procedure was a comparison of the index-linked cash values of expenditures during the entire lifetime of the plants. In doing this, in the case of nuclear power the dismantlement costs and the expenditures for the fuel cycle in particular were also included in the calculations.

Having a decisive effect on the cost advantage of nuclear power plants is the fact that rising fuel costs for a coal-fired power plant enter into the overall cost calculation to the tune of 60 percent.

Twelve Theses on Coal Conversion

1. The FRG has both hard and brown coal reserves, in quantities sufficient to last a number of centuries.

2. The FRG has a long tradition in the area of coal conversion, and it has the most extensive experiences of any co ..ry in the world.

3. Prototypes of coal conversion processes, financed by the State, are being operated successfully by various enterprises, and these have demonstrated their technological practicability.

4. The FRG is the only country in the world which embarked on a concerted development of the high temperature reactor for coal conversion, following the first oil crisis.

5. The necessary step from test plants to demonstration plants for coal conversion should be taken as soon as possible, with backing from the State.

6. Preparations should be made right now for the commercial phase of coal conversion, by means of supreme efforts, so that the necessary conditions can be created for reducing our dependence on oil imports.

7. An economically optimal utilization of our coal reserves is possible only through the employment of nuclear process heat for the coal conversion.

8. In the year 2000, SNG [substitute natural gas] could be substituted for about 50 percent of our natural gas. Above all, this would also make possible a distinct easing of the heating-energy market for liquid sources of energy.

9. A moratorium on nuclear power plants would make it impossible to introduce coal conversion to the necessary extent, since a substituting of coal for nuclear energy plus the coal conversion itself would require an additional coal requirement of 240 million tons of hard-coal units in the year 2000.

10. By the year 2000, energy imports having a value of about DM 90 billion could be eliminated specifically through coal gasification.

11. The domestic volume of investments comes to about DM 80 billion by the year 2000 with the introduction of coal gasification, so this has considerable economic significance.

12. The introduction of new energy technologies and sources of energy requires time. Even with a high level of technological commitment, decades are needed for this. Thus the most scarce resource is time. The decisions necessary for the introduction of coal conversion processes must therefore be made immediately.

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MAJOR AREAS OF R&D PROGRESS IN HARD COAL INDUSTRY

Duesseldorf BRENNSTOFF-WAERME-KRAFT in German No 9, Sep 79 p 344

/Article: "1978 Research and Development in the Hard Coal Mining Association"/

/Text/ The 1978 Annual Report again provides a glimpse into the numerous research and development activities of the Hard Coal Mining Association, Essen, which are taking on increasing significance because of the growing importance of hard coal as a component of the energy supply.

In the area of coal mining, development activity is aimed at decreasing mechanical breakdowns of mining and transportation equipment and at the stepwise integration of all tunneling and face-working operations into an efficient mining system. Showing promise in this connection is the development of a microcomputer which, among other things, is suitable for control, monitoring, measurement and data transmission tasks. In the area of tunnel driving, there is also development support. A focal point is the generation of new concepts for tunneling machines. Successful experiments in stone crushing using a combination of ferruled drills and high-pressure water jets operating at pressures of 2,000 to 4,000 bar open up the future possibility of economically driving tunnels of less than 1,000 m in length with smaller and lighter tunnel-driving machines. In transportation and supply engineering, new avenues for increasing the efficiency of car hauling over long distances have been opened with the development of large train systems with train units up to 1,000 t and speeds of 40 km/h. Underlining the significance of this development is the fact that in German hard coal mining, about 700,000 t of coal and tailings, about 30,000 t of material and about 80,000 people must be transported underground each work day.

In the area of coal upgrading, better utilization of coal, environmental protection and economics provide the impetus for improving conventional and developing new transformation processes. Improvement of sorting and drying is the development focus in the area of hard coal processing. Recently undertaken was a research project for the determination of trace element behavior in hard coal. In the coking sector efforts are concentrated on improving environmental protection, expanding the coal base, increasing productivity and improving process control in coke installations.

for generating electricity from coal in an environmentally compatible manner, work is proceeding on fluid bed firing which will make possible improved utilization of coal and higher thermal efficiency of power plants. Planning work is almost finished for construction of a gas turbine installation with pressurized fluid-bed firing, having a combustion chamber thermal power of 25 MW and a coal throughput of 4 t/h.

Further development of processes for gasification and liquefication of coal is being pursued vigorously. Mining Research is collaborating with the Nuclear Research Facility, Juelich GmbH; Rhein Lignite Works, AG and members of the reactor industry on the assembly of mature subsystems for a prototype coal-gasification installation using high-temperature nuclear-reactor heat. The associated semitechnical research facility for coal gasification, which was put into operation in the middle of 1976, has produced good results to date. Further satisfactory experimental operation will result in the construction--planned for 1981--of a pilot plant for further testing of the process. Also, in the area of coal liquefication, tests at the Coal Oil Technical Institute were successful; it was possible to improve the economics of the coal hydrogenation process which was used in Germany up to the end of World War II. The results achieved provide basic data for the construction of a demonstration plant (see "CONSTRUCTION START FOR BOTTROP COAL-OIL FACILITY," BWK 31, 1979, p 317) by Ruhr Coal, AG and Veba Oil, AG. The plant will have a coal throughput of 200 t/h.

9160
CSO: 3102

EXTENSIVE COAL LIQUEFACTION, GASIFICATION PLANNED

Munich SUEDDEUTSCHE ZEITUNG in German 10 Oct 79 p 23

/Article: "Bonn Will Upgrade Coal With DM 12.5 Billion/

/Text/ Bonn. The Federal Government in collaboration with the German states and industry will press in the coming years for speedy development and construction of pilot and demonstration plants for gasification and liquefication of lignite and hard coal. In an initial study related to the production of synthetic fuel from coal, the Ministry of Research calculated the investment cost for six plants at about DM 12.5 billion. Preliminary projects will be instituted in the current year.

In order to learn the intentions and capabilities of industry in connection with coal refining, Minister of Research Volker Hauff recently asked all interested businesses to answer a comprehensive questionnaire by the end of this month. The Federal Government is proceeding, independent of the results of this questionnaire, on the belief that industry considers the planned coal program to be basically realizable from the standpoint of technology. In order to accelerate the development work, the Ministry of Research in Bonn has already had preliminary projects for large demonstration installations worked out which can be built upon the available experience from the government supported pilot plants. Initial proposals for the preliminary projects are expected by Minister Hauff in the near future. The Ministry of Research, which up to 1979 has spent about DM 650 million to support the development of processes for the production of synthetic fuel from lignite and hard coal, will in the coming year along lay out about DM 200 mi lion for this purpose.

Four Processes

Presently, four processes for conventional gasification of coal are supported by the government, specifically: the Lurgi pressure gasification process, the Texaco process, the Saarberg-Otto process and the high-temperature Winkler process. The pilot plants for the first three processes which are presently under construction or in operation were designed for operation with hard coal while the last was designed to use lignite. The experimental facilities, with a coal throughput of up to 10 t/h, produce, as a rule, a synthetic gas which

is a mixture of carbon monoxide and hydrogen with a lower heat value than natural gas. The demonstration plants which will go into operation after 1983 will have a coal throughput of at least 50 t/h and will remain in operation for longer periods of time. Presently, two large plants are under discussion for construction before the end of the 1980's: a large coal-gasification plant in the Ruhr region near Dorsten and a large plant for producing gas from lignite located in the Rhein lignite region.

Both the gasification and liquefication of lignite are presently almost economical operations, but only in the neighborhood of the mining site. In the case of hard coal, this is true only when using suitably priced imported coal. After completion of the pilot phase, the government is counting on the probability that large-scale installations for the liquefication of coal can be built about the middle of the 1980's in the Saar region, the Ruhr region and possibly also in the North German coal region based on imported coal. The experts in the Ministry of Research expect that lignite, which is chemically more reactive than hard coal, has greater initial chances of being profitably used in large plants.

In the Ministry of Research it is clear that the present production capacity in German lignite surface mining can support, at most, the additional requirements of one large lignite-liquefication facility. A further expansion, it is said, would necessarily place in question the supply base of the Rhein-Westphalian Electric Company (RWE), AG. A reasonable energy-policy strategy would be use for hydrogenation the lignite released by shutting down old lignite power plants; these, however, would in all probability have to be replaced by nuclear power plants. Hard coal offers, on the other hand, the greater potential for generating gas and liquid products since domestic production alone, neglecting imports, is three times as great as that of lignite.

Flanking Measures

The form and extent of utilization of new technologies in the gasification and liquification of coal depends, in the opinion of the Ministry of Research, decisively on the price development of primary fossil fuels during the 1980's. For this reason, flanking measures for assuring profitability must be taken into consideration now. In the opinion of the Ministry of Research, things to be considered include:

1. Introduction of a consumer gas tax
2. Exemption of synthetic fuels from public taxation, a so-called "synthetics preference"
3. Investment allowance for construction of facilities
4. A guaranteed minimum price in product marketing
5. Use of tax revenue to make up the difference between production costs and the price of petroleum.

However, the Ministry of Research warns about too much optimism. The problems in site selection and authorization of these new facilities would be very great. Operating consortiums would have to be formed. And all of this takes time. The impression created from time to time to the effect that coal can be liquefied in the short term using the technology of World War II surpasses reality in all cases.

9160
CSO: 3102

DAMPING OF NOISE INCREASES FACTORY EFFICIENCY

Duesseldorf HANDELSBLATT in German 3 Oct 79 p 188

/Article by Hartmut Hoffmann: "Damping Noise Also Provides Economic Advantages"/

/Text/ The harmful effects of noise on health occupy an important place among occupational illnesses. Noise levels of 85 to 120 dB(A) /dB = decibel/ occur in metalworking plants. The need to control the harmful effects of noise is thus undisputed. Parliament has established limiting values of 85 and 90 dB(A), respectively.

Jobs at presses are especially noise-intensive. Investments for noise prevention are not only essential, they can also provide economic advantages. Noise is caused mainly by the gearbox, the operation of the clutch and brake and by the load on the press in the working cycle. Basically this noise can be reduced in two ways. One method involves design measures to prevent or decrease the development of noise at the source (primary noise prevention), the other method involves stopping sound propagation by the use of enclosures or shielding (secondary noise prevention).

Noise from the gears is effectively decreased by single or double helical teeth, close tolerances in the manufacture of toothed gears, by operation in an oil bath and by a special arrangement of the gears with the press.

The noise from clutch and brake operation is particularly annoying if the presses operate on a single stroke. It can be extensively reduced by the use of pnuematic or hydraulic clutch-brake systems which are muffled in operation.

The noise during operation--this is often the time of the highest noise levels-develops from the contact of the tool with the piece being worked and from the sudden change in load on the press during deformation. But there are also remedies for this.

The noise created by the contact of tool and workpiece depends on the velocity of contact. In order to achieve a low contact velocity without decreasing the number of strokes by the press, a drive system was developed which provides low tool speed in the work cycle and high tool speed in the noncutting

cycle. This drive system, installed in a 6,300 kN /kilonewton/ cutting press, lowered the noise level at the work position below the limit which is recognized today as being hazardous to health.

First of all, the height of the noise level during a load change on the press depends on the time element involved in this load change. It is especially short in cutting sheets. The sudden cutting through of the material after reaching the necessary cutting power is the reason. Since the preloaded press swings out freely, there is, as a result, a strong emission of sound. This noise can be reduced by so-called damping of the cutting impact. At the moment of breaking through the sheet this additional damping creates a counterforce in the tool which prevents the sudden decrease in stress on the press and thus the press unloads slowly and more quietly.

Use of the primary measures described results in an effective decrease in noise when used on presses up to a maximum of 100 strokes per minute.

However, if we are dealing with high-speed presses up to 2,000 strokes per minute, then the requisite decrease below 85 dB(A) in the noise level is not accomplished by primary measures. In such cases, it is more efficient to dispense completely with cost-intensive primary measures and to optimize the plant in terms of purely economic approaches; this means, for example, automating and achieving noise damping and insulation via secondary measures. Thus, the noise pressure level at the work position at a coin embossing press in an enclosure was lowered from the original 110 dB(A) to under 85 dB(A). Additional costs and space requirements for the enclosure are kept down by having the elements of the enclosure be an integral part of the press.

In the case of large presses for deep drawing and cutting of automobile chassis parts, there are other ways to decrease the effect of noise. Complete enclosure is out of the question in this case because of the size of the machinery. However, in actual practice, for example, it was possible to reduce the number of operators who are directly exposed to noise from nine to three by connecting the machines together automatically. Moreover, automating these installations doubled output. In addition, because the noise from shifting was suppressed in installations in continuous operation, it was possible to lower the noise levels to below 90 dB(A) by means of partial enclosure--a substantial step forward for a press works.

For the greater majority of presses we have to figure on additional investments to decrease noise. The more the noise pressure level is to be lowered, the more progressively these costs go up.

The efficient use of primary measures on newly developed presses--this depends on the kind of use in question and the necessary noise reduction--requires additional investments ranging from 5 to 25 percent. However, it must be remembered that these costs can be completely justified economically because of economically because of the other advantages of primary noise prevention measures, such as, for example, increased amount of tool output per grind, lower shock effects on the environment, and so forth.

With the use of secondary measures, enclosures and the like, for example, these additional investments for reducing noise are somewhat lower. Of course, they generally presuppose an automated installation.

The emission of noise from machines and plants will have to be further reduced in the future--through an efficient combination of a variety of primary and secondary measures. In this regard, it is already clear today that noise prevention investments are not only necessary for humanitarian reasons, but can also have a direct economic advantage.

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ECONOMIES OF NEW TOOL-CHANGING TECHNIQUES EXPLORED

Duesseldorf HANDELSBLATT in German 3 Oct 79 p 189

/Article by Christian Nedess: "Tool Changing Opens Up Reserves of Economic Efficiency"/

/Text/ More than $200 billion are spent every year throughout the world on metal cutting. Of this total, approximately $4 billion are for cutting tools with geometrically determined cutting edges, that is, 2 percent of the costs involved in metal cutting. However, it would be wrong to interpret this to mean that this kind of tool is accorded secondary importance in the overall system. In contrast to the 2 percent of direct tool costs, there is a range of cost responsibility of about 20 percent which is subject to adjustment.

Or, stated another way, the basis for savings of up to $40 billion annually is provided by optimal tool systems. Production per unit of time is determined by the tool by virtue of the permissible cutting conditions, wear characteristics, chip runoff, the achievable surface finish and tolerance, and handling.

Economic efficiency in processing comes as a result of the interaction of workpiece, tool and machine tool with the involvement of man in his respective sphere of responsibility. On the other hand, humanization of the world of work is by no means an empty slogan, but rather an ever-important task. Thus, in respect to the tool, tool changing has twofold importance:

First, there is the handling of more or less heavy parts, and second, there is the expenditure of time required for changing the tool. The time required for tool changing stands in constrast to the costs which arise as direct costs from the availability of an operator or adjuster. Beyond that, additional costs occur when a machine tool or entire machining plants are stopped. These costs can be called indirect tool changing costs.

The concept of tool changing has not been unambiguously described. Nonetheless, it basically includes changing the tool-cutting edge, a tool part and the entire tool.

Changing the tool cutting edge was made possible quite simply by the turnover plate technique. Depending on the tolerance requirements placed on the workpiece, changing the cutting edge means only turning or reversing the tip or further adjustment of the cutting edge to size. In the first generation of the reversible tip, the effort was made not to grind in, on the job, the deflection shoulder required during continuous chip formation, but rather to select rigid or adjustable chip-breaking shoulders, which can be attached, as the means of shaping chips. However, these had the same disadvantage as those that were ground in had, namely, they had to be adjusted to processing conditions which were altered according to circumstances. This meant more time which had to be added on to tool-changing time.

Modern turnover plates have an advanced chip-shaping geometry. Over a broad range of applications, it guarantees sure chip shaping, which is absolutely essential in automated manufacturing. But even in manually controlled processing, achieving favorable chip shapes is of decisive importance, because faulty chips coming off for an extended period of time increase the danger of an accident at the work position and make it necessary to stop the machine frequently in order to remove the chips.

Basically three systems for clamping the turnover plate can be recognized:
1. Clamping from above (or below) with a claw, finger or wedge and/or eccentric
2. Clamping via drilling, using lever, screw, eccentric and pin and wedge
3. By combined clamping from above and via drilling.

From the point of view of rapid plate changing the highest ratings are earned by those clamping systems which are distinguished by optimal accessibility, minimal number of loose individual parts and fewest possible ways of loosening the clamping, given appropriate clamping safety and the least possible undesirable influence by the chip flow. Toggle levers and spring clamping, just like wedge clamping, are of particular interest in this connection.

New Setting Necessary

Typical tools in metal cutting are turning, milling and boring tools. The most widely used turning tool today is the clamping holder with a rectangular or round shaft for external and internal cutting. As a rule, tool changing with this tool is done by loosening and tightening several clamp screws on the tool holder. Since, as a rule, with these tools we are not dealing with precision tools, a new setting is for the most part necessary.

To speed up tool-changing in a machine, four solutions can be mentioned by way of example:
1. the use of precision holders,
2. the use of preadjusted tools in which case the advance setting is done by appropriate setscrews,
3. an appropriate design of the shaft region which makes possible rapid and safe tool-changing,
4. the use of couplings which make possible partial tool changing.

A shaft designed according to VDI /Association of German Engineers/ 3425 can be mentioned as an example of a design that is finding increasingly greater use. This has a cylindrical shaft with gearing and a center bore in the adjoining shoulder.

Tools structured of individual elements were pointed out as a fourth solution. Typical realizations of such tools today are cutting heads and modules. These elements can be preadjusted and, beyond that, are characterized by particularly favorable handling.

If one takes heavy cutting as an example, in the past it was possible to change tools only with the help of a crane. With the use of modules, on the other hand, easy manual tool changing is possible. The combination of regular and small modules is not infrequent. Thus, finishing operations which likewise occur with heavy cutty are taken care of. Especially advantageous solutions in respect to tool-handling and tool-changing are achieved when tool-user, tool-manufacturer and machine-producer work together closely in the design stage.

As in turning, milling provides a similar example of simple and easy tool-changing: the cap-design in which the milling tool consists of a cutting ring and a carrier support. A screw is enough to fasten the relatively light cap.

In respect to changing cutting edges, the spring clamp systems mentioned at the beginning have substantial advantages. The turnover plate technique did not stop with turning and milling. The use of reversible tips is also increasing in drilling, boring and form drilling.

Accelerated Tool-Changing

While formerly turnover plates were primarily restricted to larger bore diameters, the bore diameter possible is steadily getting smaller. In addition to tool design proper, this decisively influences the turnover plate and its clamping. In this connection, in the area of smaller dimensions, center screw clamping gains in importance on the basis of geometric relationships. In respect to the time needed for tip-changing, this clamping is nevertheless inferior to others. Therefore, there are advantages to solutions in which either a tool part or the tool itself can be quickly changed at the machine in addition to the tip-change itself.

In the case of the ejector drill and with soldered as well as turnover plate equipment, a quadruple thread with appropriate pitch provides the quickest change.

A further possibility of accelerated tool changing is offered by the so-called bayonet holder whose function is familiar from examples in everday life. It is frequently used especially in boring tools.

Rapid tool-changing in combination with easy handling will also determine the development of tools in the future. In addition, tool development will also

be influenced by the opportunities offered by the cutting material and tip geometry and by the workpiece because of more recent design characteristics and construction materials.

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BRIEFS

CERAMIC TOOL BITS--Better cutting of steel is said to be possible with the use of the new "SN 80 Steelmaster" ceramic bit, which Feldmuehle AG in Duesseldorf presently has on the market to round out its offering of familiar SPK cutting ceramics for casting materials. New alloying metals ostensibly have raised the bending strength and toughness of the oxide ceramics, while the antiwear properties are said to have been preserved. According to the company, the Feldmuehle ceramic bit should now provide substantial economic advantages in steel cutting, too. [Text] [Duesseldorf HANDELSBLATT in German 3 Oct 79 p 19]
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ALTERNATIVE ENERGY SOURCES IN SWEDEN TESTED

World's Largest Wind Powerplant

Stockholm DAGENS NYHETER in Swedish 18 Sep 79 p 41

[Text] The two wind power plants which are now about to be built on Gotland and in Scania will have a total effective power of 5 million watts. These two plants will become the world's hitherto largest wind power plants, and they will cost a total of 82.7 million kroner. The costs will be defrayed by the state.

The two plants will supply a total of 14.5 million kilowatthours to the electric power networks of Vattenfall and Sydkraft as of the summer of 1982. The cost per kilowatthour will be approximately 18 öre, but this will include the costs of an extensive research and development program.

The United States is at present building an even larger wind power plant. It will supply 9.8 million kilowatthours a year with winds similar to those reigning in Scania. It will be put into operation in the summer of 1980. If the plant is put in serial production, the cost per kilowatthour may be reduced to 9 öre.

Denmark has an extensive wind power program. The Danish state, for example, pays 30 percent of the cost price of small windmills for private homes and vacation cottages. The plant built on an independent basis at Tvind has still not been completed. It, for example, still lacks the electrical boiler installation which will supply the major portion of the power. The power of the wind power plant will amount to 2 million watts.

The Swedish experimental plant at Älvkarleby was started in the spring of 1977 and supplies, at the most, 60,000 watts.

Test Tower for Wind Research

Stockholm DAGENS NYHETER in Swedish 9 Oct 79 p 34

[Article by Claes Sturm]

[Text] Since a few days ago, a 120-meter high steel tower has been towering over the Scanian plain at Maglarp (between Malmö and Trelleborg). It is a narrow, slender tower, at a distance looking like a sewing needle; in actual fact, it is an enormous mechanical construction, and it is the beginning of the exploitation of wind power.

The tower will be equipped with measuring devices which will record the velocity and direction of winds as well as temperatures at different heights, and, via cables, these measurements will be relayed directly to SMHI [the Swedish Meteorological and Hydrological Institute] at Norrköping, and they will form the basis for the actual windmill which will be standing ready in 1982 a few hundred meters from there.

"It is, indeed, a windy corner they have chosen. It may even be too windy," says Gunnar Olmats, design engineer of the anemometer tower.

Olmats and his fellow-workers, Carl-Axel Bergström and Richard Olofsson, had thought that it would take them 2 weeks to erect the tower, but it took them longer than that. For several days the wind was so strong that the tower swayed too much for them to work in it.

The structure consists of 24 sections, each measuring 5 meters, which are assembled in the field and then hoisted up to be mounted on top of each other. Each section weighs 370 kgs., and when the wind has been stronger than 10 m./sec., they have had to remain down below.

Fine View

Finally, however, all of the sections have been put in place and secured by means of their 800 bolts. The wind measuring apparatus will now have to be mounted at seven different levels, a job at least as laborious. It takes 30-45 minutes to climb to the top and just as long to get down again, safe and sound.

That is to say if one has not forgotten the wrench.

On the other hand, however, and if one does not suffer from fits of dizziness: A finer view of the luncheonettes than the tower construction people have had during the last few clear days cannot be imagined. They have had a view of considerably more than seven parishes.

In the construction, open steel sections have been used. They are more rust-resisting and, above all, are more easily checked for rust than are the pipes otherwise normally used in the construction of towers such as this one, for example in the construction of most of the television towers which just now require repair work costing millions of kroner, just because of the rust.

4 x 80 Meters High

The team has previously erected the same kind of anemometer tower on Gotland. On the basis of the test readings from there, the Karlstad Engineering Plant will build a windmill. Here at Maglarp, the Karlskrona Shipyard will guarantee the wind power plant, the tower of which will be only 80 meters high and the 75-meter big propeller blade of which will hopefully provide enough power to cover the needs of 500 homes.

In that case, it will be considerably more than was obtained when, some years ago, on almost the same spot, they drilled 2,000 meters into the ground for oil.

Home Solar Heating

Stockholm DAGENS NYHETER in Swedish 15 Oct 79 p 14

[Article by Mert Kubu]

[Text] Sweden's first completely solar-heated development of small houses is called Lambohov and is located on the outskirts of Linköping. It consists of 55 rowhouses grouped around a gigantic hot-water dam. The occupancy rate is very good. The interest in the project is great. But the solar energy at Lambohov will become expensive. Converted to per kilowatthour (kw.-hr.) energy, it will cost as much as 1.50 kronor.

This would correspond to an electricity bill of approximately 24,000 kronor per year for a family today living in an electrically heated rowhouse.

The current cost of electricity for an electrically heated house is approximately 20 öre per kilowatthour. Converted to prices of home heating oil, the energy price at Lambohov would correspond to about 8,000 kronor per cubic meter of oil.

But the owners of the 55 rowhouses at Lambohov need not be particularly anxious. During the evaluation period of at least 5 years, they will pay the same price for their heat as the municipality charges for district heating. After that time, the costs will be revised, and it is expected that the state will subsidize the additional costs compared with traditional heating costs.

Necessary

Lambohov is a necessary experiment on the road towards a large-scale solar heat production, if any. The costs of the lesson have been forbidding. Everybody agrees on that. But, at the same time, the project shows that the road is difficult and takes some time.

Technically, the solar heating system at Lambohov functions as follows: The rowhouses have been constructed with big, overhanging roofs to the south. The roofs facing south consist of solar collectors, filled with water. The sun-heated water is pumped to a shaft, blasted into the mountain. It is a 12-meter deep and 35-diameter big dam. According to calculations, in the fall, the surfac water of the dam is approximately 70° warm, at the bottom perhaps 50°. In February, the surface temperature has dropped to 35°.

The surface of the water dam is insulated by means of floating polyetrane discs and, finally, covered with plastic cloth. The hot water is conveyed via a thermal plant for heating back to the rowhouses. At the same time, the water for tapping is heated in separate tanks with the sun-heated water. When the water in the dam drops too low, three heat pumps may be connected up to the system to raise the temperature of the water.

It is a strange feeling to stand at the edge of the dam. Ten years ago, such solutions to the heating of residential homes would have been considered inconceivable. But in order for the storage of the solar heat of the summer for the winter to become economical, at least 10 times as big water storage facilities are needed.

It is the building firm of Östgöta-Byggen at Linköping, a pioneer in Sweden when it comes to solar heating, which has built Lambohov. Some years ago, they built one of the first solar-heated homes in the country. Lambohov, built with aid from the National Swedish Institute for Building Research, is the second step.

What is it then that costs so much? The dam has become costly, approximately 4 million kronor. The solar collectors cost 2.5 million kronor. The solar-heat plant, the distribution system, the heat pumps and the control equipment cost a lot of money. The total cost of the solar heating system amounts to close to 10 million kronor for 55 houses.

Testing in Practice

The outcome per house is thus that the additional costs are high. Part of it can be explained by the fact that most of the parts have to be specially ordered. But even if, through mass production and refined techniques, similar projects may be produced at a lower cost, it does not pay to invest in such small units.

The idea with Lambohov is to study whether the solar-heating technique works in practice, and what can be improved before going on.

The rowhouses of 155 square meters cost 365,000 kronor each and have been built on leasehold land. The fist 14 families have already moved in. During the winter, the basin will be heated provisionally by means of portable oil burners. Next summer,.the heating will be done by means of solar power.

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